2016 ANNUAL REPORT

Groundwater Monitoring and Whole-House Filter Program for Moses Lake Wellfield Superfund Site (Former Larson Air Force Base)

Moses Lake, Washington

CERCLIS Site No. WAD988466355

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EXECUTIVE SUMMARY

The purpose of this Annual Report is to summarize findings from the 2016 Moses Lake Wellfield Superfund Site (Site) sampling program. The U.S. Army Corps of Engineers (USACE) conducted this sampling program on behalf of the U.S. Environmental Protection Agency (EPA), Region 10. The objectives of this sampling program are 1) to ensure protection of human health by sampling groundwater and comparing contaminant concentrations to the federal drinking water maximum contaminant level (MCL) for Site contaminants such as trichloroethene (TCE), and 2) to gather baseline data prior to the implementation of groundwater pump and treat systems. As part of the sampling program, USACE also installs and maintains whole-house filter (WHF) treatment systems at ten private properties to prevent human exposure to TCE and related contaminants of concern (COCs) at levels that exceed the MCLs.

The 2016 sampling program consisted of four sampling events that occurred in February, May, August, and November. During the 2016 sampling program, the TCE MCL (5.0 micrograms per liter [µg/L]) was exceeded in approximately 33% of the monitoring and extraction wells. Neither the TCE MCL nor the cis-1,2-dichloroethene (cis-DCE) MCL was exceeded in the private wells. However, the TCE MCL was exceeded in WP-04, the well that services Granite Construction for industrial purposes.

USACE sampled approximately 68 private wells and 75 monitoring and extraction wells over the course of the year, and also replaced granular activated carbon (GAC) annually for the private wells with WHFs. There have been no detections of TCE or cis-DCE in the mid or effluent samples from the WHFs (the latter leads into the homes), which confirmed that the WHFs are protecting human health. An action threshold of 2 µg/L TCE has been used to place private wells on quarterly sampling (as opposed to annual sampling), and an action threshold of 3.5 µg/L TCE has been used to determine which private wells receive a WHF. In 2016, no private wells exceeded the TCE action threshold of 3.5 µg/L; thus, no WHFs were installed.

At EPA's request, in May 2016, four private wells and four monitoring wells were sampled for perfluorinated alkyl acids (PFAAs). There were no detects of PFAAs in the private wells; however, three of the four monitoring wells exceeded the EPA health advisory for combined perfluorooctanesulfonic acid (PFOS) and perfluorooctanoic acid (PFOA). Also in May 2016, 12 monitoring wells and 8 private wells were sampled for 1,4-dioxane. No wells exceeded EPA's screening level of 0.67 µg/L. During the 2015 sampling program, samplers noticed a petroleum smell emanating from monitoring well 00BW01. In May 2016, 00BW01 was sampled for diesel range organics (DRO), gasoline range organics (GRO), benzene, toluene, ethylbenzene, and xylene (BTEX). DRO was the only detected constituent.

A WHF efficiency memo was prepared for WP-125 and WP-123. The memo concluded that the WHFs are working sufficiently to reduce TCE. There were no detections of TCE in the mid or effluent ports.

A seasonal trend analysis was prepared and submitted to EPA in August 2016. The trend analysis covered a subset of wells that were sampled quarterly (eight sampling events) from June 2014 through February 2016. The trend analysis identified seasonal trends and specified the months that the monitoring wells (January) and private wells (some in January, some in August) should be sampled to capture the highest TCE concentrations.

Recommendations from the 2015 sampling program and the status as of the end of 2016 are provided in Section 6. Because the work plan for 2017 had already been finalized on November 3, 2016, before 2016 events were completed, recommendations from the 2016 sampling program were not fully known at that time. Thus, recommendations made in this Annual Report, also in Section 6, might not be implemented until 2018.

Contents

Figures (located after text)

Tables (located after text)

ACRONYMS

1,1-DCE	1,1-dichloroethene
ADR	Automated data review
AFB	Air Force Base
BTEX	Benzene, toluene, ethylbenzene, xylene
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
cis-DCE	cis-1,2-dichloroethene
CSM	Conceptual site model
COC	Contaminant of concern
1,2-DCA	1,2-dichloroethane
1,1-DCA	1,1-dichloroethane
DERP-FUDS	Defense Environmental Restoration Program - Formerly Used Defense Sites
DQIs	Data Quality Indicators
DQOs	Data Quality Objectives
DRO	Diesel range organics
DoD QSM	Department of Defense Quality Systems Manual for Environmental Laboratories
DSHS	(Washington) Department of Social and Health Services
GAC	Granular activated carbon
GRO	Gasoline range organics
IA	Interagency Agreement
IROD	Interim Record of Decision
MCL	Maximum contaminant level
MWH	Montgomery Watson Harza
NC	Not calculated
µg/L	Micrograms per liter
PDB	Passive diffusion bag
PE	Performance evaluation
PFBS	Perfluorobutanesulfonic acid
PFAA	Perfluorinated alkyl acids
PFHpA	Perfluoroheptanoic acid
PFHxS	Perfluorohexanesulfonic acid
PFNA	Perfluorononanoic acid
PFOA	Perfluorooctanoic acid
PFOS	Perfluorooctanesulfonic acid
QC	Quality Control
QAPP	Quality Assurance Project Plan
QCSR	Quality Control Summary Report
RI	Remedial Investigation
RL	Reporting limit
ROE	Right-of-entry
SEDD	Staged electronic data deliverable
TCE	Trichloroethene
trans-DCE	trans-1,2-dichloroethene
1,1,1-TCA	1,1,1-trichloroethane

USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
VC	Vinyl chloride
VOC	Volatile organic compounds
WDOE	Washington State Department of Ecology
WDOH	Washington State Department of Health
WHF	Whole-house filter

1. INTRODUCTION

The purpose of this Annual Report is to summarize findings from the 2016 Moses Lake Wellfield Superfund Site (Site) groundwater sampling program. The U.S. Army Corps of Engineers (USACE) conducted this sampling program on behalf of the U.S. Environmental Protection Agency (EPA), Region 10, pursuant to the 2008 Interim Record of Decision (IROD) for the Site (EPA 2008) and the 2016 USACE Work Plan-Quality Assurance Project Plan (WP-QAPP; USACE 2016). USACE provides ongoing technical assistance focused on groundwater sampling and whole-house filter (WHF) maintenance as required to protect human health. This report is organized as follows:

- Section 1: Introduction
- Section 2: Sampling and Field Activities for 2016
- Section 3: Analysis, Data Validation, and Results
- Section 4: State Well Inventory Database Search
- Section 5: Summary and Discussion
- Section 6: Recommendations

1.1. 2016 Sampling Program Scope of Work

The scope of work for the USACE 2016 sampling program consisted of the following activities:

- Notifying residents of 2015 annual sampling results in early 2016;
- Obtaining and updating rights-of-entry (ROEs) for site access;
- Awarding a new WHF base contract for WHF maintenance;
- Maintaining and servicing the WHF treatment systems;
- Preparing a WHF efficiency memo;
- Preparing a seasonal trend analysis to ascertain the months with highest TCE concentrations;
- Collecting, analyzing, and evaluating contaminant of concern (COC) data and groundwater elevation data in groundwater monitoring wells;
- Collecting, analyzing, and evaluating COC data in unfiltered private wells and private wells with WHF systems
- Sampling a subset of wells for perfluorinated alkyl acids (PFAAs), specifically perfluorooctanesulfonic acid (PFOS) and perfluorooctanoic acid (PFOA); 1,4-dioxane; diesel range organics (DRO); gasoline range organics (GRO); and benzene/toluene/ethylbenzene/xylene (BTEX);
- Coordinating and contracting with laboratories and subcontractors for data analysis and data validation;

- Updating the project database (EQuIS™) with sampling results and updating an Excel spreadsheet with sampling results;
- Updating the online mapping system with TCE results;
- Reviewing the Washington State Department of Ecology (WDOE) well inventory database for newly constructed private wells that may be at risk for COCs; and
- Preparing a WP-QAPP for the 2016 work; and preparing an Annual Report summarizing 2016 activities (this document).

1.2. Site Background

The Site is located within and beyond the northwestern region of the City of Moses Lake, Washington. See Figure 1 for the Site's location and Figure 2 for the institutional control (IC) boundaries and plumes. The Site encompasses approximately 15 square miles and includes the Grant County International Airport and surrounding area (formerly the Larson Air Force Base [LAFB]), commercial facilities, and residences.

Previous environmental investigations conducted at the Site identified contamination of soil and groundwater resulting from historic operation of the former LAFB and industrial activities associated with the aircraft industry. Potential source areas are scattered throughout the Site, and approximately 1000 acres of groundwater have been identified as contaminated to date.

Previous investigations focused primarily on the former LAFB. The former LAFB occupied approximately 9607 acres and was active from 1942 until 1966. In 1988, three municipal wells operated by the City of Moses Lake were found to be contaminated with trichloroethene (TCE). Additionally, TCE was historically detected in two domestic wells operated by the Skyline Water System, Inc., a private water provider located in unincorporated Grant County south of the former LAFB property. Domestic (residential) and commercial (light or heavy industrial) private well locations outside the former base have also had detections of TCE. TCE concentrations associated with the Site have been found to exceed EPA's National Primary Drinking Water Standards (the maximum contaminant level [MCL]) under the Federal Safe Drinking Water Act. The MCL represents the maximum level (i.e., concentration) of the contaminant allowed in drinking water, and is set at 5 µg/L for TCE.

Based on the TCE detections described above, between 1989 and 1993 the city chose to fix the three contaminated city water-supply wells south of the airport by extending the casings down to the lower basalt aquifers. In addition, the Skyline community, which was dependent on the Skyline water system, received an alternative water source (bottled water) between 1997 and 2003. In 2003, USACE completed construction of a replacement water-supply well, which draws water from a deeper, uncontaminated groundwater aquifer and currently provides drinking water to the Skyline community.

Following findings of contaminated domestic (private) wells and upon request from Region 10 EPA, USACE began a private well groundwater sampling program in 2001. The groundwater sampling program has been used to ensure that humans are not exposed to contaminant concentrations above the MCL, and to monitor TCE plume migration. Under this program, drinking water from private wells[1] and small drinking water systems (Group A and B systems)[2] were sampled (with some gaps between sampling events) for TCE-related compounds. Recently, USACE has also been sampling monitoring wells at least annually, and those data are presented with the results from private wells and small drinking water systems in an annual report (this document). City of Moses Lake wells are routinely sampled for VOCs per Washington State Department of Health (WDOH) requirements, and the results are posted on WDOH's website. However, since the wells that WDOH samples are all screened below the contaminated aquifers, those data are not included in this report.

For ease of reporting, small drinking water systems are reported as part of private wells. The majority of private wells sampled are located in the Cascade Valley area immediately downgradient of the main (north) and south plumes (see Figure 4 through Figure 12). In 2002, following two private well monitoring events, a WHF treatment system was designed and installed at five residential sites where it was determined that TCE contamination could potentially exceed the drinking water standard for TCE (5 µg/L).

Groundwater monitoring wells have been installed over the last 22 years in order to monitor contamination at the Site. Groundwater elevation data are collected where available to evaluate groundwater flow direction and are also used to evaluate plume migration at groundwater monitoring wells.

An IROD was signed in September 2008 (EPA 2008) for cleanup actions in areas with soil and groundwater contamination that exceed risk-based concentrations. The IROD required groundwater pump and treat systems to be installed for two of the five identified TCE plumes. The IROD further specified that cleanup levels will be attained throughout all the plumes, but active remediation may be discontinued if it can be demonstrated that natural attenuation (through dilution) can remediate the remnant plumes in a reasonable timeframe (within an estimated 30 years for cleanup).

The IROD specifies that information gathered during groundwater monitoring, as well as design and operation of the selected groundwater pump and treat system, be used to determine the need for refinement of the selected groundwater remedy to meet groundwater restoration goals. Currently, EPA is designing a pump and treat system for the south plume that is anticipated to be operational in 2018 (see Figure 2). Information from operation of the south plume pump and treat system will be used to make decisions on a second pump and treat system that is planned to be installed for the main plume.

The COCs monitored in the groundwater sampling program are as follows:

- trichloroethene (TCE)
- cis-1,2-dichloroethene (cis-DCE)
- trans-1,2-dichloroethene (trans-DCE)

1 Private wells consist of wells used for drinking and other domestic uses, and industrial process wells.
2 A "Group A" public water system is defined in RCW 70.119A.020 as a public water system with at least 15 service connections regardless of the number of people; or a system serving an average of 25 or more people per day for at least 60 days per year, regardless of number of service connections; or a system serving 1,000 or more people on two or more consecutive days. A "Group B" public water system is any public water system that does not meet the definition of a Group A system. For ease of reporting, small drinking water systems are reported as part of private wells.

- vinyl chloride (VC)
- 1,1-dichloroethene (1,1-DCE)
- 1,2-dichloroethane (DCA)
- 1,1,1-trichloroethane (TCA)
- 1,1-dichloroethane (1,1-DCA)

Only TCE, however, has a cleanup level established in the IROD, and the other VOCs have either never been detected or have been detected only at levels significantly below any established MCL or risk-based cleanup level.

1.3. Geologic Setting

The Site occupies a nearly flat fluvial terrace bounded to the east by Crab Creek and to the south and west by Moses Lake. The geologic units affected by contamination include, with increasing depth and from youngest to oldest, the following: sand and coarse gravel deposited by huge glacial floods (Hanford formation), silt and sand deposited in lakes and rivers (Ringold Formation, locally eroded away to the north and east), and several extensive basalt flows of the Wanapum Basalt Formation. The Wanapum Basalt at the Site is divided into three members as follows, from geologically youngest to oldest: the Priest Rapids Member, the Roza Member, and the Frenchman Springs Member. At the Site, the Roza Member consists of three basalt flows, of which Roza 1 is the youngest and always the first encountered. The Priest Rapids Member overlies the Roza Member in the central portions of the Site, but is mostly highly weathered and has been eroded away entirely along the east and west margins. The basalt flows typically have a vesiculated, fractured, and sometimes brecciated flowtop overlying a dense flow interior characterized by vertical cooling fractures. The deeper and less weathered the basalt flows are, the more likely these fractures are to be completely filled by secondary minerals (EPA 2008).

Figure 3 illustrates the hydrogeologic conceptual model, which shows the geological members as defined in the IROD. The hydrostratigraphic units relevant to the Site are as follows (EPA 2008):

- Hanford Formation (**aquifer** in areas, but unsaturated beneath a substantial portion of the Site)
- Ringold Formation (water-confining unit, absent in areas)
- Priest Rapids and flow-top of Roza 1 (**aquifer**)
- Dense flow interior of Roza 1 (water-confining unit)
- Roza 2 flow top (**aquifer**)
- Dense flow interior of Roza 2 (water-confining unit)

TCE has been detected in all three aquifers described above, indicating that there is some connectivity between the units and the aquifers. For example, the highest concentrations of TCE are found in the Priest Rapids and flow-top of Roza 1 aquifer, which indicates that water is able to move through the Ringold Formation. The TCE occurrence and migration pathways are also illustrated on Figure 3, showing the complexity of contaminant flow through the fractured basalts.

Monitoring well nomenclature is based on the hydrogeologic conceptual model. The Hanford Formation aquifer is generally associated with the "AW" series of monitoring wells; the Priest Rapids and Roza 1 aquifer is associated with "BW" series of monitoring wells; and the Roza 2 basalt flow is associated with the "CW" series of monitoring wells. An example of monitoring well nomenclature is 12BW05, which represents a well drilled in 2012 (12), screened within the Priest Rapids and Roza 1 aquifer (BW), and fifth in the BW monitoring well installation series (05) for that year.

TCE contamination is found primarily in the upper basalt aquifers (Priest Rapids and Roza 1, and Roza 2). Some of the private wells may be drawing water from the overlying alluvium, but driller logs suggest that the majority of the private wells are open only in basalt. Some draw from several basalt flows, but rarely from below Roza 2.

1.4. Previous Investigations

Please see prior Annual Reports for a summary of previous investigations.

1.5. USACE Investigation Strategy

The USACE investigation strategy, with input from EPA, includes sampling groundwater monitoring wells and private wells to ensure protection of human health by comparing the results to the federal drinking water MCL for Site contaminants such as TCE that resulted from historic Site activities. The investigation strategy for monitoring wells and private wells was provided in the WP-QAPP for 2016 and is adjusted each year for the sampling program.

1.5.1. Groundwater Monitoring Wells and Extraction Wells

Groundwater monitoring well sampling has been focused on identifying TCE concentrations, tracking plume extent and migration, and collecting groundwater elevation data to evaluate groundwater flow direction. Samples have been collected using dedicated bladder pumps or passive diffusion bags (PDBs). The majority of the monitoring wells are located east and northeast of the Cascade Valley area (see Figure 4).

Groundwater analytical data will be used to assess plume migration before and after the groundwater pump and treat system is operational, and will support groundwater contour modeling. Monitoring data will be used to assess the effectiveness of the future south plume groundwater pump and treat system in restoring groundwater to federal drinking water standards and state cleanup levels.

1.5.2. Private Wells

The Moses Lake IROD requires preventing human exposure to COC concentrations in groundwater that are above their MCLs. TCE is the focus for interim groundwater monitoring activities, since it is the only COC that historically has exceeded its MCL (5 µg/L) and is the only groundwater COC listed in the IROD. The investigation strategy for the private well sampling program historically began with a list of existing private wells within the 5 µg/L TCE plume boundary or near the leading edge of the plume boundary. The majority of private wells sampled are located in Cascade Valley immediately downgradient of the main and south plumes (see Figure 5). Some well owners were recruited for the private groundwater sampling program in the 1990s and early 2000s. Other residents have asked to be included in the sampling program over the years. USACE successfully recruited many additional home owners in 2012/2013, and the private well network was also optimized in 2013 to remove a number of non-detect wells that were outside of the plume area. As more information has become available that helps identify private wells that may be affected by TCE contamination, well owners have been and will continue to be recruited for evaluation.

The 2016 sampling strategy for private wells was to sample annually the entire suite of wells, and quarterly those with either WHFs or TCE detections that have historically been greater than 2.0 µg/L. Groundwater elevation data are not obtained from the private wells due to the potential for entangling the water level indicator cable with pump plumbing and/or cables present in the private wells.

2. SAMPLING AND FIELD ACTIVITIES FOR 2016

The 2016 sampling program consisted of four events that occurred in February, May, August, and November, as described below. A detailed report for each sampling event can be found in Appendix A (Field Sampling Reports). Table 1 lists the wells that were sampled for each event, and Appendix B includes comprehensive analytical results for all 2016 events.

A summary of each sampling event is provided below for groundwater monitoring wells and private wells. USACE only sampled properties where the well is located and for which we had rights-of-entry (ROEs). No sampling was conducted at homes that are supplied by neighboring wells; however, in many cases ROEs have been obtained to facilitate sending sampling results.

Private wells with WHFs (see Table 2) were sampled at the influent port (upstream of the filtration system), at the mid port (between the lead and lag filter units), and at the lag port (downstream of the lag filter unit and prior to water entering the residence) after granular activated carbon (GAC) replacement. WHFs were inspected every six months to ensure all parts were working properly and to replace the fines filters; both GAC vessels of each system were replaced annually. Private wells without WHFs were sampled from a water tap as close to the well head as possible.

2.1. Event 1 (February 2016)

2.1.1. Groundwater Monitoring Wells

During Event 1, 31 groundwater monitoring wells consisting of seven bladder pump wells and 24 PDB wells were sampled for VOCs in accordance with the WP-QAPP. Groundwater elevation data were collected from all sampled monitoring wells. After samples were collected, PDBs were deployed in wells without dedicated bladder pumps.

2.1.2. Private Wells

During Event 1, ten private wells with WHFs were sampled for VOCs. WP-14, WP-70, WP-83, WP-86, WP-119, WP-121, WP-123, WP-124, and WP-129 were sampled at the influent port only to document incoming TCE concentrations. WP-125 was sampled from the influent, mid, and effluent sampling ports to document the presence of TCE in the influent port and evaluate efficiency of the filters based on the results from the effluent port. Before sample collection, totalizer flow meter readings were recorded.

Five private wells without WHFs (WP-04, WP-27, WP-131, WP-167, and WP-168) were also sampled for VOCs because TCE concentrations between 2 and 3.5 µg/L had been detected at those locations during previous sampling events. Data collected from these wells was used for the seasonal trend analysis.

For the 2016 sampling program, EPA requested on January 26, 2016, that the USACE sample certain compounds in addition to VOCs at select wells as follows:

- PFAAs at private wells WP-119, WP-121, WP-124, and WP-125 via Method 537

However, incorrect bottles were provided by the lab and insufficient water was collected. Therefore, the February samples could not be analyzed (they were sampled in May instead).

2.2. Event 2 (May 2016)

2.2.1. Groundwater Monitoring Wells

During Event 2, 75 groundwater monitoring wells consisting of 39 bladder pump wells and 36 PDB wells were sampled for VOCs in accordance with the Work Plan-QAPP. Groundwater elevation data were collected from all sampled monitoring wells. After samples were collected, PDBs were deployed in wells without dedicated bladder pumps.

For the 2016 sampling program, EPA requested sampling of certain compounds in addition to VOCs at select wells as follows:

- PFAAs at monitoring wells 04BW04, 04CW01, 91AW14, and 99BW16; monitoring well 99AW10 was planned to be sampled; however site access was not safe and no sample was collected.
- 1,4-dioxane at monitoring wells 00BW10, 00BW12, 00BW15, 02BW01, 04BW05, 12BW02, 12BW07, 14BW01, 99BW01, 99BW12, 99BW15, 99BW16; and
- DRO, GRO, and BTEX at 00BW11.

2.2.2. Private Wells

In May 2016, GAC vessels were replaced at five WHF residences (WP-14, WP-70, WP-83, WP-86 and WP-125). Before sample collection, totalizer flow meter readings were recorded. After the GAC vessels were replaced, the mid and effluent ports were sampled for VOCs to ensure the filter systems were working properly. Analytical results confirmed that the WHFs reduced effluent concentrations to below the TCE action threshold.

During Event 2, five additional private wells with WHFs were sampled for VOCs. WP-119, WP 121, WP-123, WP-124, and WP-129 were sampled at the influent port only to document incoming TCE concentrations.

In May 2016, 58 private wells without WHFs were also sampled for VOCs. However, several additional wells could not be sampled: the owner at WP-118 did not answer (b) (6) [redacted] and the property is (b) (6) [redacted]; WP-25W was not functioning; and WP-88, WP-175, and 176 were not occupied.

For the 2016 sampling program, EPA requested sampling of certain compounds in addition to VOCs at a subset of wells as follows:

- 1,4-dioxane at WP-168, WP-121 (influent only), WP-125 (influent only), WP-144, WP-45, WP-52, WP-69, and WP-74.

The PFAAs that were unsuccessfully collected in February, were successfully collected in May at WP-119, WP-121, WP-124, and WP-125, all of which have WHFs. The influent and effluent ports were sampled.

2.3. Event 3 (August 2016)

2.3.1. Groundwater Monitoring Wells

No monitoring wells were sampled during the August 2016 sampling event. PDBs were deployed in some monitoring wells to be sampled in November 2016.

2.3.2. Private Wells

During Event 3, ten private wells with WHFs were sampled for VOCs. WP-14, WP-70, WP-83, WP-86, WP-121, WP-123, WP-124, and WP-129 were sampled at the influent port only to document incoming TCE concentrations; WP-125 was sampled from the influent, mid, and effluent sampling ports to document the presence of TCE in the influent port and efficiency of the filters based on the results from the effluent port. Before sample collection, totalizer flow meter readings were recorded.

Five private wells without WHFs (WP-04, WP-27, WP-131, WP-167, and WP-168) were also sampled for VOCs in August 2016. These wells were sampled because TCE concentrations between 2 and 3.5 µg/L were detected at those locations during previous sampling events.

2.4. Event 4 (November 2016)

2.4.1. Groundwater Monitoring Wells

During Event 4, 32 groundwater monitoring wells consisting of eight bladder pump wells and 24 PDB wells were sampled for VOCs in accordance with the WP-QAPP. Groundwater elevation data were collected from all sampled monitoring wells.

2.4.2. Private Wells

In early November 2016, GAC vessels were replaced at three WHF residences: WP-119, WP-121, and WP-123. WP-124 and WP-129 were delayed with EPA approval to early 2017[3]. Before sample collection, totalizer flow meter readings were recorded. During Event 4, five private wells with WHFs were sampled for VOCs. WP-14, WP-70, WP-83, WP-86 and WP-125 were sampled at the influent port only to document incoming TCE concentrations. WP-119, WP-121, WP-123, WP-124, and WP-129 were sampled from the influent, mid, and effluent sampling ports to document the presence of TCE in the influent port and efficiency of the filters based on the results from the effluent port.

Five private wells without WHFs (WP-04, WP-27, WP-131, WP-167, and WP-168) were also sampled for VOCs. These wells were sampled because TCE concentrations between 2 and 3.5 µg/L were detected at those locations in previous sampling events.

2.5. Right-of-Entry Acquisition

Right-of-entry (ROE) forms are used to obtain permission to enter onto property to conduct water sampling. In general, USACE only obtained ROEs from property owners (and tenants, if applicable) where a well is located. During 2016 sampling year, USACE acquired new ROEs at WP-154, WP-131, WP-54, WP-152, and WP-145. During 2016 sampling year, USACE was unable to acquire ROEs for the following wells:

- WP-11: The owner indicated on May 17, 2016, that he did not want the Government involved with his property. He is on well water.
- WP-137: The owner was amenable to having his water sampled but did not want to sign an ROE. The EPA remedial project manager, who was onsite during the May 2016 sampling event, approved sampling this property without an ROE.

USACE will continue to make an attempt at least annually to acquire an ROE.

3. ANALYSIS, DATA VALIDATION, AND RESULTS

The sections below discuss analytical and data validation procedures; groundwater elevations and analytical results for monitoring/extraction wells; and analytical results for private wells. A comprehensive table of all analytical results is provided in Appendix B.

3.1. Analytical and Data Validation Procedures

All sampling and analytical activities were executed in compliance with project data quality objectives, and the results are considered acceptable for use.

The analytical laboratory used for this project was Analytical Resources, Inc. (ARI) of Tukwila, WA. Samples were analyzed by EPA Method 524.3 for VOCs, by Publication ECY97-602 for DRO and GRO, by EPA Method 8021 for BTEX, by EPA Method 522 for 1,4-dioxane, and by EPA Method 537 for

[3] The WHF sampling program was revised for 2017 so that water would be sampled BEFORE filter exchange, to ensure that the WHFs remain protective in the last month(s) before exchange.

PFAAs. These methods produce data with the analytical sensitivity required to evaluate whether drinking water meets the federal MCLs for applicable analytes. A Quality Control Summary Report (QCSR) summarizing analytical performance expressed in terms of data quality indicators (DQIs) can be found in Appendix F.

Laboratory Data Consultants, Inc. (LDC) of Carlsbad, CA, performed the data validation task. The Data Validation Report (DVR; Appendix G [cd only]) presents Stage 2a and Stage 4 data validation results for samples collected. Data validation was performed in accordance with the requirements outlined in LDC's SOW for services; the USACE Work Plan-QAPP; the U.S. Department of Defense Quality Systems Manual for Environmental Laboratories, Version 5.0 (DOD 2013); and EPA's National Functional Guidelines for Superfund Organic Methods Data Review (EPA 2016). Based on the data quality assessment presented in the QCSR and the DVR, the overall quality of data is known and acceptable for the intended use. In 2016, the PFAAs were validated by USACE staff rather than LDC because the request from EPA to analyze PFAAs occurred after LDC's contract was put in place. Rather than modify the contract, EPA approved USACE staff to validate the data.

Water samples and associated quality control (QC) samples were collected from groundwater monitoring wells and private wells in accordance with the WP-QAPP. Field QC samples included field duplicates, field blanks, trip blanks, matrix spikes (MSs), and matrix spike duplicates (MSDs). A performance evaluation (PE) sample, provided by Environmental Resource Associates of Arvada, CO, was submitted for VOC analysis during the November 2016 sampling event.

3.2. Monitoring Wells - Results

3.2.1. Groundwater Elevations

Groundwater elevations recorded during sampling are presented in Table 3. The data from May 2016 were used to create groundwater contour plots for the Priest Rapids/Roza 1 and Roza 2 aquifers. The data were interpolated using the Kriging method and created using the computer program Surfer Version 13 from Golden Software.

The general flow direction in the Priest Rapids-Roza 1 aquifer in the northern portion of the Site is to the southwest (see Figure 7), which is consistent with previous groundwater elevation data. The groundwater flow direction within the south plume is southerly, which is consistent with previous groundwater elevation data.

The flow direction in the Roza 2 aquifer radiates to the northwest and south from well 12CW03; well 12CW03 is located in the northern portion of the south plume (see Figure 8). The contours were blanked between 12CW04 and the other Roza 2 monitoring wells to the north due to lack of data. The exact location of the peak elevation of the groundwater in the Roza 2 aquifer is not known due to this lack of data.

The software-generated groundwater contours were reviewed by a hydrogeologist and deemed to be accurate. The data for the groundwater elevation figures are based on Event 3 (May 2016) only.

Groundwater elevation data were not collected from private wells due to the risk of entangling the water level indicator cord with private well pumps. In addition, unless the residents' and neighbors' use of water could be controlled, the elevations collected would not be indicative of natural contours.

3.2.2. Analytical Results

Analytical results for TCE in the groundwater monitoring and extraction wells are provided in Table 4 and shown in Figure 9 (Priest Rapids-Roza 1) and Figure 10 (Roza 2). The highest TCE result from any of the four events was used to generate the figures. Of the 75 monitoring and extraction wells sampled, 32 wells had no detections above the reporting limits for VOCs, 43 wells had TCE detections above 0.2 µg /L, and a subset (six) also had cis-DCE detections. Twenty-five of those 43 wells exceeded the MCL (5.0 µg /L) for TCE. The maximum TCE detection in the Priest Rapids-Roza 1 aquifer was 92.2 µg /L in well 12BW05 in November 2016, which was slightly less than the maximum TCE concentration (106 µg /L) in November 2014 and slightly more than the maximum TCE concentration (89.3 µg/L) in November 2015. The maximum cis-DCE detection in the Priest Rapids-Roza 1 aquifer was 2.74 µg /L at well 04BW06 in May 2016. The maximum TCE detection in the Roza 2 aquifer was 6.10 µg/L at well 04CW07 in November 2016. Well 04CW07 is the only Roza 2 monitoring well that exceeded the TCE MCL (5.0 µg /L); it is located below the southern portion of the south plume. There were no cis-DCE detections in the Roza 2 aquifer.

For 2016, EPA also recommended sampling PFAAs at a subset of monitoring wells. Of the six PFAAs reported, all six were detected in May 2016: perfluorooctanesulfonic Acid (PFOS), perfluoroheptanoic acid (PFHpA), perfluorohexanesulfonic acid (PFHXS), perfluorononanoic acid (PFNA), perfluorobutane sulfonic acid (PFBS), and perfluorooctanoic acid (PFOA). In addition, monitoring wells 91AW14, 99BW16, and 04CW01 exceeded the provisionary health advisory level established by EPA for combined PFOS and PFOA. See Figure 11 for the 2015 and 2016 PFAA results (2015 results from two additional monitoring wells were included at EPA's request).

EPA's health advisory, which identifies the concentration of PFOA and PFOS in drinking water at or below which adverse health effects are not anticipated to occur over a lifetime of exposure, is 0.07 parts per billion (70 parts per trillion) for PFOA and PFOS. Health advisories are non-regulatory and reflect EPA's assessment of the best available peer-reviewed science. The results are presented in Table 5.

EPA also requested that the emerging contaminant 1,4-dioxane be sampled at a subset of monitoring wells across the site. Of the 12 monitoring wells sampled for 1,4-dioxane, only four wells had detections above the detection limit. None of the wells exceeded the screening level of 0.67 µg /L.

In addition, USACE had noticed strong odors in well 00BW11 in 2015; consequently, in 2016, USACE analyzed a sample for DRO/GRO/BTEX, and only DRO was detected at 100 µg/L. There is no EPA MCL for DRO; however, the Model Toxics Control Act (MTCA), Washington's cleanup law, has a groundwater cleanup level of 500 µg /L.

3.3. Private Wells without WHFs– Results

This section summarizes the results for private wells without WHFs.

3.3.1. Analytical Results

Analytical results for the private wells without WHFs are provided in Table 6. TCE and cis-DCE were the only analytes detected out of the eight VOC analytes evaluated in 2015. Of the 58 private non-WHF well locations sampled, TCE results can be summarized as follows: 18 had no detections (i.e., results were < 0.2 µg/L), and 40 had TCE detections at or above 0.2 µg/L. Of those 47, WP-04, WP-131, WP-167, and WP-168 had TCE concentrations above 2.0 µg/L for at least one event and were sampled quarterly. WP-27 was also sampled quarterly during the 2016 sampling year because it had historical detections greater than 2.0 µg/L; however, none of the 2016 results were above 2.0 µg/L. WP-04 exceeded the TCE MCL (5.0 µg/L); however, this well is not used for drinking water. Five private wells had cis-DCE detections.

The maximum TCE concentration was 6.23 µg/L at WP-04 in May 2016. The maximum cis-DCE concentration was also at WP-04 in May 2016; the cis-DCE concentration was 2.09 µg/L, though this value is considerably lower than the cis-DCE MCL (70 µg/L). Well WP-04 is used for industrial process water and had TCE concentrations that were consistently above the MCL during all 2016 sampling events. Between February 2016 and November 2016 the TCE concentrations ranged from 5.84 to 6.23 µg/L, and the graph in Appendix D shows a rising trend. No WHF is needed at this location because the water is not being consumed. The business associated with WP-04 has been previously informed of the elevated risk associated with TCE. EPA provided signage for the business to place on the well house and at other locations where workers could come in contact with contaminated water.

No private wells (except for WP-04 as discussed above) exceeded the TCE action level of 3.5 µg/L that triggers installation of a WHF; thus, no WHFs were installed during the 2016 sampling program.

3.4. Private Wells with WHFs – Results

The analytical results and the efficiency of the WHFs are discussed below.

3.4.1. Analytical Results

Table 7 provides the TCE and cis-DCE analytical results for the private wells with WHFs. Table 8 summarizes purge volumes and totalizer readings collected prior to sampling at WHF wells. For the 2016 sampling year, the WHFs were successful in reducing TCE and cis-DCE to undetected concentrations in the effluent ports, which lead into the homes, indicating that the WHFs are working effectively. Contractor-analyzed spent GAC did not exceed any Toxicity Characteristic Leaching Procedure (TCLP) thresholds in 2016.

3.4.2. Whole-House Filter Efficiency Analysis

In June 2016, USACE staff prepared a Whole-House Filter Efficiency Memo (see Appendix C) that evaluated the efficiency of the Siemens AWC-1230 WHF systems installed in September 2014 and April 2015 at Moses Lake private wells WP-123 and WP-125. USACE staff reviewed TCE concentrations and totalizer readings over a year-long period to evaluate whether the filters worked sufficiently to protect residents from exposure to TCE concentrations greater than the MCL. In addition, this memo evaluated whether there was sufficient evidence to reduce filter sampling frequency from quarterly to something less frequent.

The memo concluded that the WHFs are working sufficiently to ensure protection of human health. USACE staff recommended continuing to sample the WHF influent ports quarterly (at the time the memo was prepared) at WP-123 and WP-125 to evaluate seasonal trends. USACE staff also recommended that the sampling frequency for the mid and effluent ports could be reduced to annual sampling and still protect human health based on the current flow rates, TCE concentrations, and assumption of annual replacement of WHF GAC vessels and fines filters. See also Section 6.1.3.

3.5. Seasonal Trend Analysis for Trichloroethene

A seasonal trend analysis for TCE was prepared and submitted to EPA in August 2016. The trend analysis covered a subset of wells that were sampled quarterly (eight sampling events) from June 2014 through February of 2016. The objective of the analysis was to evaluate seasonal fluctuations in TCE concentrations within private wells and monitoring wells (including extraction wells) to identify which season or month had the highest concentrations so that one season or month could be targeted for future sampling events. The results for monitoring wells indicated that there is a strong correlation between groundwater elevations and TCE concentrations, and that sampling in January would result in the highest TCE concentrations. Private well TCE concentrations did not correlate as strongly to groundwater elevations in the Hanford Formation and Priest Rapids-Roza 1 aquifers. Unlike the monitoring wells, there was no consistent seasonal influence on maximum TCE concentrations. Based on professional judgment, the report recommended to sample specific private wells in January and August to further evaluate potential maximum concentrations.

3.6. Customer Notification of 2016 Results

The results from the 2016 sampling program (the content of this 2016 Annual Report) are expected to be mailed in February 2017.

4. STATE WELL INVENTORY DATABASE SEARCH

To determine whether additional private wells were installed within or near the VOC plume (within the IC boundary), information from the WDOE Well Logs database[4] was queried. The well logs for those wells in or near the IC boundary are provided in Appendix H. The locations of those wells, plus additional wells outside of the IC boundary, are shown on Figure 12.

The database was searched for wells constructed or well logs received between January 1, 2016 and December 31, 2016 and screened or open to the upper basalt flows in Priest Rapids-Roza 1 and Roza 2 geologic members (see Figure 3). Following the Groundwater Institutional Control Boundary (see Figure 2), all or portions of the following Township, Range, and Sections were queried: T19N, R28E, Sections 4, 5, 6, 7, 8, 9, 16, 17, 18 and T20N, R28E, Sections 16, 17, 19, 20, 21, 22, 27, 28, 29, 30, 31, 32, 33, 34.

Thirteen wells were identified in the query and two of those wells are located near other wells that have had detections of TCE. BHW096 is located southwest of WP-18N and WP-18S, and BIU598 is located in Cascade Valley near WP-111; USACE recommends both for annual sampling. Both wells appear to be

[4] https://fortress.wa.gov/ecy/waterresources/map/WCLSWebMap/textsearch.aspx

drawing groundwater from the Roza 1 aquifer. Groundwater from these formations has historically had TCE contamination in some areas.

5. SUMMARY AND DISCUSSION

Summary and discussion of the TCE plume and WHF work for 2016 is provided below.

5.1. Site TCE Plume Discussion

During the 2016 sampling program, the TCE MCL of 5.0 µg/L was exceeded in approximately 30% of the monitoring and extractions wells, primarily in the Priest Rapids/Roza 1 monitoring wells. Regarding the private wells, approximately 58 of the 71 private wells (including WHFs) located in the Cascade Valley had detections of TCE (> 0.20 µg/L) during the 2016 sampling program; however, only WP-04 (Granite Construction) exceeded the TCE MCL of 5.0 µg/L.

TCE concentrations for each well are summarized in Figure 6, Figure 9, and Figure 10. For wells that were sampled during multiple events, the maximum TCE concentration was chosen (not all were sampled multiple times). The contours were initially generated using the Kriging gridding method in Golden Software's Surfer® program Version 13, which numerically estimates plume boundaries based on input data. The Surfer® Kriging method used a log-transformed distribution. Where deemed appropriate, the computer-generated contours were adjusted based on professional judgment (e.g. open-ended contours used where there are data gaps). The Priest Rapids/Roza 1 main plume is open-ended to the southwest due to lack of monitoring well data in the downgradient direction. The Priest Rapids/Roza 1 northeast plume is only defined by one monitoring well (99BW15) and two private wells (WP-14 and WP-83). The northeast plume contours are open to the northeast due to lack of data in the upgradient direction. The Priest Rapids/Roza 1 South Plume is open-ended to the southwest due to lack of monitoring wells and uncertainty of where private wells are screened.

It is anticipated that private wells, including those in the Cascade Valley, draw water from the upper basalt aquifers (Priest Rapids-Roza 1 and Roza 2) and potentially the overlying alluvium. However, limited private well construction information makes it difficult to correlate individual private wells with a specific aquifer. In addition, there are only two groundwater monitoring wells located within the Cascade Valley, and they are too distant from the other clusters of monitoring wells to help delineate the origin of groundwater contamination occurring in the Cascade Valley. The majority of private wells in Cascade Valley are downgradient from or near the leading edge of the contaminant plume. Several of the wells sampled in the Cascade Valley area are immediately downgradient of the main (north) and/or south plumes. Additional monitoring wells upgradient of Cascade Valley are expected to be installed in February 2017 and will be sampled to better understand plume migration. The new monitoring data will help refine the conceptual site model (CSM), help predict TCE concentrations at residential wells, and delineate the extent of TCE contamination in the Priest Rapids/Roza 1 and Roza 2 aquifers.

TCE results from WP-04 exceeded the TCE MCL of 5 µg/L during every sampling event in 2016. There are multiple homes with WHF systems clustered near WP-04; however, it is unclear if these homes are drawing water from the same plumes. None of the homes located near WP-04 have exceeded the TCE MCL of 5 µg/L, though during the 2015 sampling program, WP-125 exceeded the action level of 3.5 µg/L and received a WHF system. Contours around WP-04 are open to the northeast due to lack of data in the upgradient direction. Current data suggest that the private wells downgradient of WP-04 (generally southwest, see Figure 5) without WHF systems are the most at risk of exceeding the TCE MCL. Based on the groundwater elevation contours for Priest Rapids/Roza 1 monitoring wells (Figure 7) and the 2016 TCE contours (Figure 9), the source of TCE contamination in the northern Cascade Valley could be from the main TCE plume or an unidentified source.

Following the June 2013 sampling event, USACE recommended and EPA agreed to 2.0 µg/L TCE as the lower threshold value above which private wells would be monitored quarterly for a minimum of one year given the limited amount of available historic data for private wells. This recommendation was made to evaluate groundwater fluctuations based on seasonal changes (i.e., change in irrigation activities, decrease in precipitation, etc.) and determine whether fluctuations would necessitate action to prevent ingestion of contaminated drinking water. This recommendation for quarterly sampling of private wells ended with February 2016 to generate data for trend analyses.

Due to the presence of multiple contaminant plumes and uncertainty of private well construction, private wells within the Moses Lake area with any historic COC detections are recommended for continued annual sampling until a better understanding of plume migration has been documented. Additional houses may be added based on their proximity to wells with elevated concentrations.

5.2. Suggested Improvements to Sampling Program

To help with understanding the plumes, USACE recommends installing pressure transducers and data loggers (both referred to as transducers) to monitor groundwater levels at the Site. Groundwater elevation data at the site are currently collected during groundwater sampling events, which have occurred one to four times per year. The current groundwater elevation monitoring frequency is adequate when there are no changes to the groundwater flow regime. However, the groundwater flow regime at Moses Lake will be affected by increased flows in Crab Creek and the operation of a pump and treat system. Transducers allow for several groundwater level measurements per day to be collected, which can be used to observe fluctuations in groundwater elevations that periodic groundwater level monitoring would not record. Several changes in short-term groundwater elevations that could be important to document include the following:

- **Changes in flow direction and gradient**. Changes in the flow direction and gradient can affect the movement of contaminants at the site
- **Hydraulic connection between different aquifers.** Recharge from Crab Creek will likely impact the Hanford Formation and Priest Rapids/Roza 1 aquifers. Groundwater elevation data may show the rate of recharge in each aquifer and the location where the largest increase will occur.
- **Rate of recharge across the site.** The timing and magnitude of groundwater elevation increases caused by recharge from Crab Creek can be used to refine estimate of groundwater flow velocity across the site.
- **Identify the optimal time to collect groundwater samples.** The highest TCE concentrations have been measured during the highest groundwater elevations.

The transducers would be placed primarily in wells screened in the Hanford and Priest Rapids/Roza 1 formations near Crab Creek and within the Priest Rapid/Roza 1 wells near the pump and treat system. Transducers would also be installed in a couple of wells spaced across the site for which historical groundwater data show the greatest fluctuations.

5.3. Whole-House Filters

The WHFs are working as intended and reducing cis-DCE and TCE concentrations in effluent samples (i.e., in the water that is supplied to the homes) below both the MCLs and the detection limits for each. The WHF GAC vessels were exchanged annually; the fines filters were replaced approximately every six months, and the WHF systems were also inspected for general functionality at that time. No new WHFs were installed in 2016. The results of the WHF efficiency analysis confirmed that the WHFs are working as intended. Based on discussion with EPA in September 2014, the WHF ports continued to be sampled in 2015 and 2016 as follows:

- In the first year after installation, all ports (influent, mid, effluent) will be sampled quarterly.
- At end of first year, an efficiency analysis will be performed.
- In the second year (assuming all is well based on the analysis), the influent port will be sampled quarterly, and the mid and effluent ports annually.
- At end of the second year, a seasonal analysis will be done to decide which quarter is best for annual sampling, with the preference of having the majority of the WHFs on the same schedule.
- In the third year and beyond, all three ports would be sampled only annually.
- USACE will strive to put the WHFs on the same schedule for annual sampling.

6. RECOMMENDATIONS

Section 6.1 includes recommendations from the 2015 Annual Report and status of their implementation as of December 31, 2016. Section 6.2 includes recommendations for 2017 and beyond based on 2016 activities.

6.1. 2015 Annual Report Recommendations and Status as of December 31, 2016

6.1.1. Groundwater Monitoring Wells

- Evaluate historical groundwater elevation data and TCE concentrations for evidence of seasonal fluctuations to ensure conservative timing of future optimized annual sampling events in the groundwater monitoring program.
    - Status: Based on the 2016 trend analysis that suggested a maximum month for TCE concentrations, all groundwater wells will be sampled annually starting in January 2017.
- Evaluate recent groundwater elevation data collected in support of the anticipated south plume pump and treatment system in parallel with historic groundwater information to ensure sufficient

baseline data are available to support pump and treat system optimization analysis following start-up of the south plume pump and treat system.

  - Status: Quarterly elevation data were collected from 2014 through 2016 to create a baseline to compare pre- and post-operation conditions of the pump and treat system.

- There are currently only two monitoring wells located in Cascade Valley. The monitoring well pair is located just south of Dick Road, which is approximately one mile south of the main plume. Installation of additional monitoring wells in the northern part of Cascade Valley is recommended to refine the CSM and determine the source of the TCE impacting the private wells.

  - Status: EPA has not asked USACE to carry out this recommendation.

- Installation of six monitoring wells in the Roza 1 basalt aquifer upgradient of Cascade Valley (generally upgradient of WP-04) and downgradient of 04BW06 is planned for summer 2016 to better define the origin of contaminant concentrations in the private wells of Cascade Valley. Presently, it is unclear whether contamination impacting the north Cascade Valley is coming from the distal portion of the main plume, or another unidentified TCE source.

  - Status: Well installation began in October 2016 and is scheduled to be completed in early spring of 2017. Figure 13 shows the approximate locations of the six new monitoring wells.

- Enter existing monitoring well boring logs and WDOE driller logs (when deemed suitable for interpretation) into a geologic database so that subsurface cross-sections can be readily generated through the main and south plumes and into Cascade Valley.

  - Status: EPA has not asked USACE to carry out this recommendation.

6.1.2. Private Wells

- Sample newly installed private well, BHW096, identified through WDOE records search. It appears to be drawing groundwater from the Roza I aquifer. Groundwater from this formation has historically had VOC contamination in some areas. Prior to sampling, USACE will obtain an ROE from homeowner.

  - Status: The house was not accessible because there are unleashed dogs on the property. A letter will be sent to the owners in an attempt to obtain an ROE so that the water could be sampled in August 2017.

- Continue collecting annual groundwater samples from all private wells with any historic COC detections to document plume migration.

  - Status: Completed; continuing in 2017.

- Continue updating the sampling program by adding new private wells, small public water systems (and monitoring wells) with high likelihood of COC detections as they are identified through Ecology's well log database.

  - Status: No new wells were added to the sampling regime in 2016. However, a WDOE well search was performed to identify new wells within the site.

- For private wells that exceed 2.0 µg/L TCE, continue collecting quarterly groundwater samples for at least four quarters to evaluate patterns in seasonal and temporal system variability that support future sampling frequency and timing recommendations.
    - Status: Completed; need to discuss future sampling frequency with EPA.
- Continue to communicate with residents who have not agreed to groundwater monitoring but are located in areas anticipated to have elevated TCE concentrations. Document attempted communication with residents, that the residents have declined to participate in the monitoring program, and that the Government has informed residents of the risks associated with exposure to water exceeding the MCL for TCE.
    - Status: Completed. See Section 2.5.
- Conduct a comprehensive review of Ecology's drillers' logs versus assigned private well numbers (WP series) and evaluate which private wells may be suitable for incorporation into a geologic database.
    - Status: EPA has not asked USACE to carry out this recommendation. This information would be useful to indicate in what geologic units the wells are installed.
- Purchase signs stating "Non-potable water, do not drink" water for Granite Construction (WP-04) due to exceedances of the TCE MCL during 2014, 2015 (and Feb 2016). Mail letter to Granite Construction informing them that they should not drink the water due to health risks. Provide signs to Granite Construction in May 2016 and continue to remind them that the water is not suitable for drinking.
    - Status: USACE mailed a letter to Granite Construction in April 2016. In May, two signs were posted at WP-04 and two more were provided to the woman at the front desk. (Note: In addition, two signs were posted on each WHF shed at WP-124 and WP-125. One sign was posted on irrigation line at WP-121).

6.1.3. Whole House Filter Systems

- Continue to install and maintain WHF systems at private wells that exceed the action threshold of 3.5 µg/L TCE.
    - Status: Maintenance occurred; no new WHFs were installed.
- Continue to monitor the efficiency of WHF systems by tracking if TCE exceeds its action level of 3.5 µg/L at the mid or effluent ports, and take steps to correct any issues.
    - Status: Completed. No homes had detections of any VOCs at the mid and effluent ports.
- Use information from the WHF totalizing flow meters, which measure the volume of water treated by the WHF systems, to monitor and evaluate the efficiency of the treatment systems.
    - Status: Completed. A WHF Efficiency Memo was completed for WP-123 and WP-125.
- Over time, if concentrations at the influent ports to WHFs decline, work with EPA to determine which WHFs can be removed from residential wells.

- Status: No WHFs have been removed from the sampling program yet.

6.2. 2016 Annual Report Recommendations for 2017 and beyond

General. USACE recommends that EPA continue to coordinate with Bureau of Reclamation (Bureau) and share information with USACE to understand the impacts of the Bureau's water management activities, since the activities may significantly affect the groundwater elevations and TCE concentrations in Moses Lake and all USACE actions taken to date (trend analysis, sampling frequency, understanding of plumes, etc).

6.2.1. Groundwater Monitoring Wells

- Install pressure transducers and data loggers in monitoring wells to monitor changes to groundwater elevations; changes could affect sampling timing and contaminant migration.

6.2.2. Private Wells

- Since 2017 will consist only of yearly sampling (except for 9 wells, which will be sampled twice), USACE recommends discussing with EPA what course of action should be taken if a private well exceeds 2.0 µg/L or 3.5 µg/L only once.
- USACE recommends adding two private wells to the sampling regime: BHW096, which is located southwest of WP-18N and WP-18S, and BIU598, which is located in Cascade Valley near WP-111. Both wells appear to be drawing groundwater from the Roza 1 aquifer. Groundwater from these formations has historically had TCE contamination in some areas.

6.2.3. Whole-House Filter Systems

- Continue servicing GAC vessels annually and fines filters approximately every six months, after sampling has occurred.

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Figures

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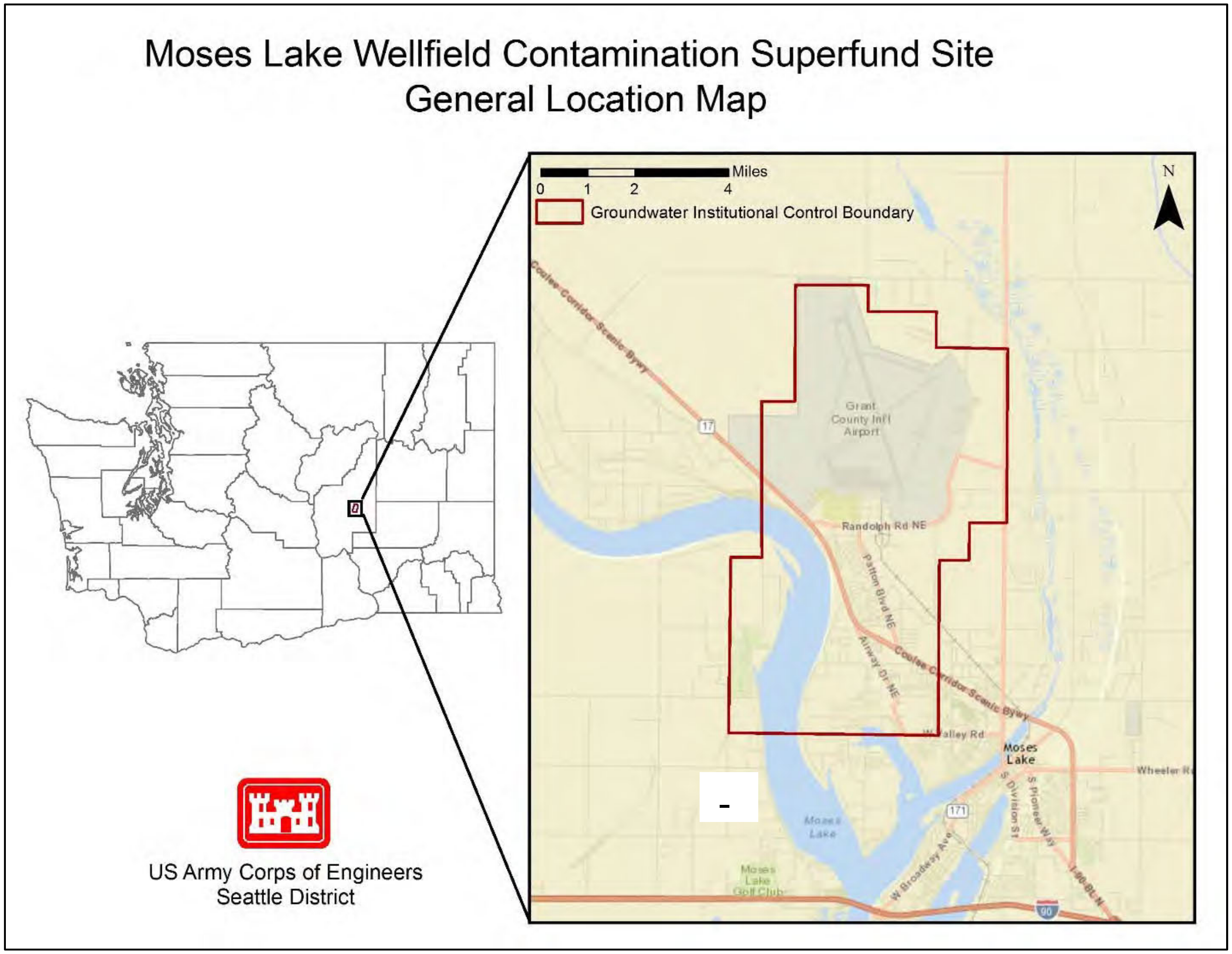

Figure 1. General Location Map for Moses Lake Wellfield Superfund Site (EPA 2008).

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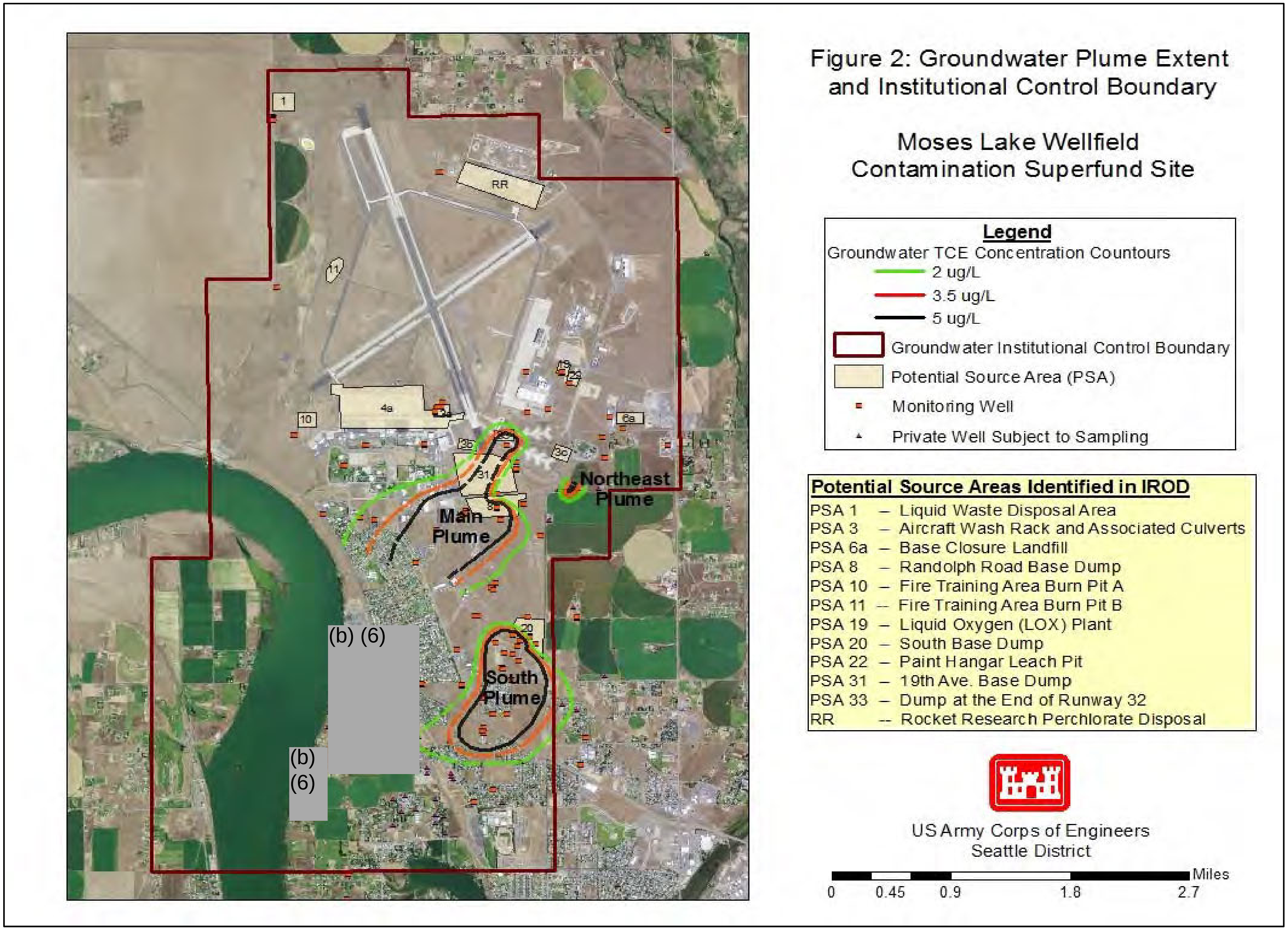

Figure 2. Groundwater plume extent as of May 2016 and institutional control boundary

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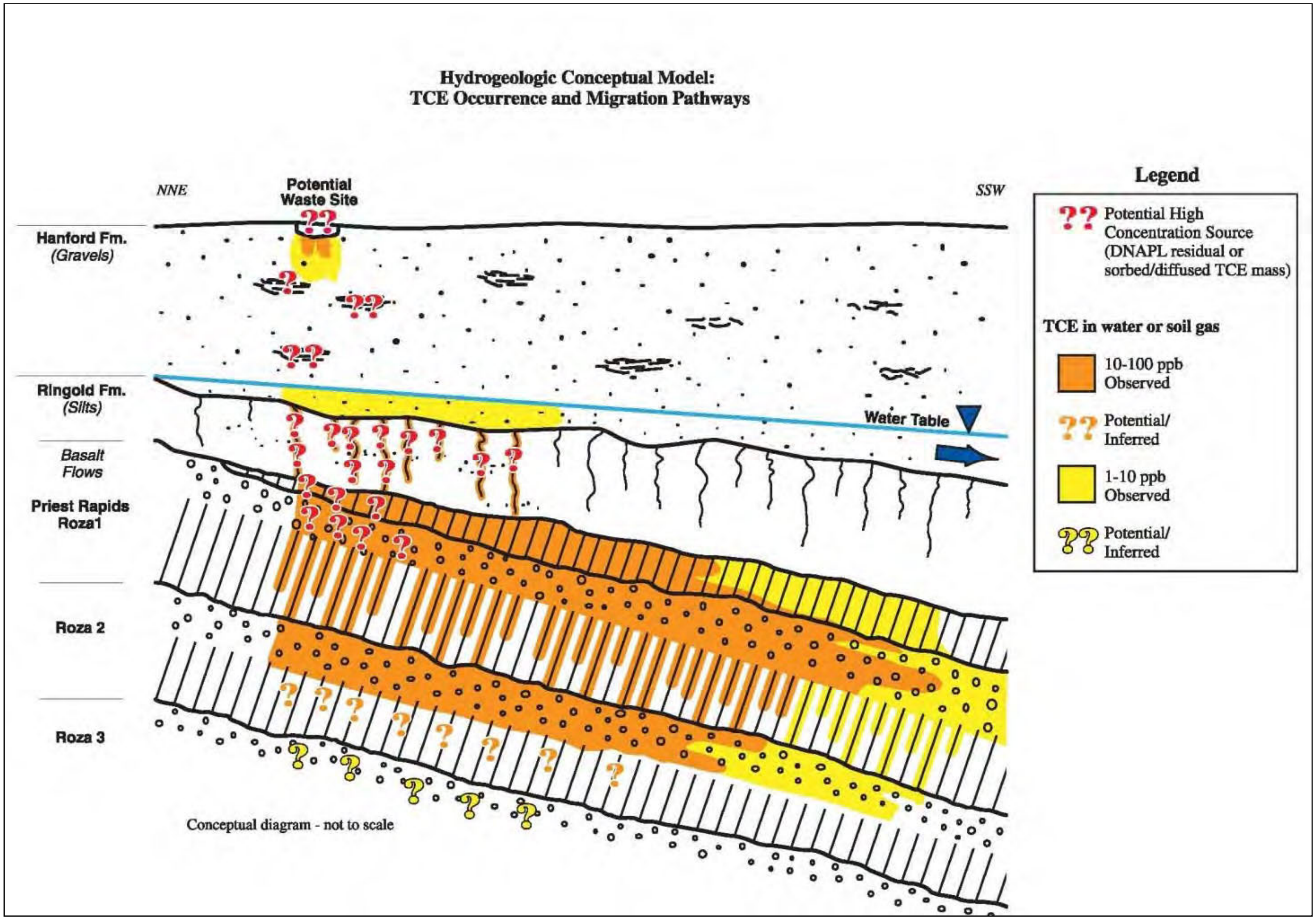

Figure 3. Hydrogeologic Conceptual Model (EPA 2008)

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NOTE: Figures 4 through 12 are located after the list of titles below.

Figure 4. Map of Wells and Sampling Status for 2016

Figure 5. Map of Wells - Cascade Valley Inset

Figure 6. Cascade Valley Inset with TCE Contours and Results (Highest Value Shown)

Figure 7. Priest Rapids-Roza 1 Monitoring Wells (BW series) with Groundwater Elevations (May 2016 Results)

Figure 8. Roza 2 Monitoring Wells (CW series) with Groundwater Elevations (May 2016 Results)

Figure 9. Priest Rapids-Roza 1 Monitoring Wells (BW series) with TCE Contours and Results (Highest Value Shown)

Figure 10. Roza 2 Monitoring Wells (CW series) with TCE Contours and Results (Highest Value Shown)

Well ID	00BW06	
Sample Date	2/24/2015	
Aquifer	Priest Rapids-Roza 1	
Unit	µg/L	
Sample Type	N	FD
PFOS	0.0100 U	0.0100 U
PFOA	0.0101 J	0.00897 J
PFOS+PFOA	0.0101	0.01897
PFHpA	0.00396 J	0.00332 J
PFNA	0.0404	0.0384
PFBS	0.0300 U	0.0300 U
PFHxS	0.0439	0.0412

Well ID	91AW14
Sample Date	5/18/2016
Aquifer	Hanford Formation
Unit	µg/L
Sample Type	N
PFOS	0.119
PFOA	0.143
PFOS+PFOA	0.262
PFHpA	0.0196
PFNA	0.0592
PFBS	0.0765
PFHxS	0.395

Well ID	99BW16
Sample Date	5/18/2016
Aquifer	Priest Rapids-Roza 1
Unit	µg/L
Sample Type	N
PFOS	0.348
PFOA	0.336
PFOS+PFOA	0.684
PFHpA	0.0427
PFNA	0.0201
PFBS	0.162
PFHxS	0.718

Well ID	91AW13
Sample Date	2/24/2015
Aquifer	Hanford Formation
Unit	µg/L
Sample Type	N
PFOS	0.0100 U
PFOA	0.00700 U
PFOS+PFOA	0.017
PFHpA	0.00300 U
PFNA	0.0488
PFBS	0.0300 U
PFHxS	0.0100 U

Well ID	04BW04
Sample Date	5/18/2016
Aquifer	Priest Rapids-Roza 1
Unit	µg/L
Sample Type	N
PFOS	0.0112 J
PFOA	0.00627 J
PFOS+PFOA	0.01747
PFHpA	0.00262 J
PFNA	0.0200 U
PFBS	0.0900 U
PFHxS	0.0217 J

Well ID	04CW01	
Sample Date	5/18/2016	
Aquifer	Roza 2	
Unit	µg/L	
Sample Type	N	FD
PFOS	0.052	0.0711
PFOA	0.105	0.14
PFOS+PFOA	0.157	0.2111
PFHpA	0.0169	0.0215
PFNA	0.0200 U	0.0200 U
PFBS	0.0318 J	0.0423 J
PFHxS	0.252	0.334

Figure 11. 2015 and 2016 Perfluorinated Alkyl Acids Results

Figure 12. Map of Private Wells (Ecology's Database) Associated with Appendix H

2016 Well Locations

Legend

Well Locations

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Figure 13. Map of Six Newly Drilled Monitoring Wells

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Tables

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Table 1. Wells Sampled during 2016 Sampling Year

	February 2016		May 2016		August 2016		November 2016	
Well ID	COC	GW. Elevation	COC	GW. Elevation	COC	GW. Elevation	COC	GW. Elevation
Hanford Formation Wells								
00AW11			V	X			V	X
99AW01			V	X			V	X
99AW08			V	X				
99AW09			V	X			V	X
91AW07			V	X				
91AW09			V	X				
91AW14			V+PFAA	X				
91AW15			V	X				
91AW17			V	X				
00BW01			V	X				
00BW02			V	X				
00BW03			V	X				
00BW04			V	X				
00BW05			V	X				
00BW06			V	X				
00BW07			V	X				
00BW09			V	X				
00BW10			V	X				
00BW11			V+DRO+GRO+BTEX	X				
00BW12			V+1,4-dioxane	X				
00BW13			V	X				
00BW14			V	X				
00BW15			V	X				
00BW16			V	X				
01BW01			V	X				
02BW01	V	X	V	X		X	V	X
02BW02			V	X				
04BW01			V	X				
04BW04			V+PFAA	X				
04BW05			V	X				
04BW06			V	X				
04BW07			V	X				
04BW09	V	X	V	X			V	X
04CW01			V+PFAA	X				
04CW02			V	X				
04CW03			V	X				
04CW04			V	X				
04CW05	V	X	V	X		X	V	X

Table 1. Wells Sampled during 2016 Sampling Year

	February 2016		May 2016		August 2016		November 2016	
Well ID	COC	GW. Elevation	COC	GW. Elevation	COC	GW. Elevation	COC	GW. Elevation
04CW07A	V	X	V	X		X	V	X
04CW07B		X		X				X
04CW08			V	X				
12BW01			V	X				
12BW02	V	X	V	X		X	V	X
12BW03A	V	X	V	X		X	V	X
12BW03B		X		X				X
12BW04A	V	X	V	X		X	V	X
12BW04B		X		X				X
12BW05	V	X	V	X		X	V	X
12BW06	V	X	V	X		X	V	X
12BW07	V	X	V	X		X	V	X
12BW08	V	X	V	X		X	V	X
12CW01	V	X	V	X		X	V	X
12CW02	V	X	V	X		X	V	X
12CW03	V	X	V	X		X	V	X
12CW04	V	X	V	X		X	V	X
12CW05	V	X	V	X		X	V	X
12EX01	V	X	V	X		X	V	X
12EX02	V	X	V	X		X	V	X
14BW01	V	X	V	X		X	V	X
14BW02	V	X	V	X		X	V	X
14BW03	V	X	V	X		X	V	X
14EX03	V	X	V	X		X	V	X
14EX04	V	X	V	X		X	V	X
14EX05	V	X	V	X		X	V	X
91BW02			V	X				
91BW03			V	X				
91BW04	V	X	V	X			V	X
92BW01	V	X	V	X			V	X
92BW02			V	X			V	X
99BW01			V	X				
99BW09			V	X				
99BW10	V	X	V	X			V	X
99BW11			V	X				
99BW12			V	X				
99BW14			V	X				
99BW15			V+1,4-dioxane	X				
99BW16			V+PFAA+1,4-dioxane	X				
99BW18	V	X	V	X			V	X
WP-03			V					

Table 1. Wells Sampled during 2016 Sampling Year

	February 2016		May 2016		August 2016		November 2016	
Well ID	COC	GW. Elevation	COC	GW. Elevation	COC	GW. Elevation	COC	GW. Elevation
WP-04	V		V		V		V	
WP-09			V					
WP-10			V					
WP-105			V					
WP-111			V					
WP-116			V					
WP-119	V		V+PFAA+1,4-dioxane		V		V	
WP-120			V					
WP-121	V		V+PFAA+1,4-dioxane		V		V	
WP-122			V					
WP-123	V		V		V		V	
WP-124	V		V+PFAA+1,4-dioxane		V		V	
WP-125	V		V+PFAA+1,4-dioxane		V		V	
WP-126			V					
WP-127			V					
WP-128			V					
WP-129	V		V		V		V	
WP-130			V					
WP-131	V		V		V		V	
WP-136			V					
WP-137			V					
WP-138			V					
WP-139			V					
WP-14	V		V		V		V	
WP-143			V					
WP-144			V+1,4-dioxane					
WP-145			V					
WP-147			V					
WP-148			V					
WP-149			V					
WP-150			V					
WP-152			V					
WP-153			V					
WP-154			V					
WP-155			V					
WP-156			V					
WP-165			V					
WP-167	V		V		V		V	
WP-168	V		V+1,4-dioxane		V		V	
WP-169			V					

Table 1. Wells Sampled during 2016 Sampling Year

	February 2016		May 2016		August 2016		November 2016	
Well ID	COC	GW. Elevation	COC	GW. Elevation	COC	GW. Elevation	COC	GW. Elevation
WP-170			V					
WP-171			V					
WP-172			V					
WP-173			V					
WP-177			V					
WP-178			V					
WP-179			V					
WP-180			V					
WP-27	V		V		V		V	
WP-28			V					
WP-33			V					
WP-45			V+1,4-dioxane					
WP-50			V					
WP-52			V+1,4-dioxane					
WP-54			V					
WP-57			V					
WP-65			V					
WP-66			V					
WP-68			V					
WP-69			V+1,4-dioxane					
WP-70	V		V		V		V	
WP-71A			V					
WP-71B			V					
WP-74			V+1,4-dioxane					
WP-82			V					
WP-83	V		V		V		V	
WP-86	V		V		V		V	
Total MW	28		75		0		32	
Total PW	15		68		15		15	

V = VOCs
X = measurement taken
PFAA = perfluoroalkyl acids

Table 2. Private Wells with Whole-House Filter Systems

WELL ID	Date WHF System Installed/Replaced	Comment
WP-14	May 2013	Replaced WHF from mid-2000s
WP-70	May 2013	Replaced WHF from mid-2000s
WP-82	Removed	Was installed in early 2000s though no detections exceeded action threshold; was removed in 2013 because results continued to be less than action threshold.
WP-83	May 2013	Replaced WHF from mid-2000s
WP-86	May 2013	Replaced WHF from mid-2000s
WP-119	Aug 2013	Newly installed
WP-121	Aug 2013	Newly installed
WP-129	Sep 2013	Newly installed
WP-124	Oct 2013	Newly installed
WP-123	Sep 2014	Newly installed
WP-125	Apr 2015	Newly installed

Table 3. Monitoring Wells – Groundwater Elevations

Well ID	Water Level Elevation Feb 2016	Water Level Elevation May 2016	Water Level Elevation August 2016	Water Level Elevation August 2016	Screen Interval	Bladder Pump Installed?	Stick Up or Flush Mount	NAD 83 Coordinates	
00AW11		1074.48		1075.4	81-91	Yes	Stick Up	47.180903	-119.30661
00BW01	1083.35	1084.76			68-78	Yes	Stick Up	47.190079	-119.28616
00BW02	1075.01	1076.04			87-97	Yes	Stick Up	47.182638	-119.306417
00BW03	1076.94	1077.44			85-95	Yes	Stick Up	47.185409	-119.303345
00BW04	1087.15	1087.32			70-80	Yes	Stick Up	47.192445	-119.298192
00BW05	1087.58	1087.74			80-90	Yes	Stick Up	47.195435	-119.294518
00BW06	1051.93	1050.92			180-190	Yes	Stick Up	47.189802	-119.338849
00BW07	1081.96				75-85	Yes	Stick Up	47.192043	-119.301497
00BW08	1076.42	1077.26			92-102	Yes	Stick Up	47.192293	-119.316264
00BW09	1086.99	1087.16			79.5-89.5	Yes	Stick Up	47.196831	-119.301469
00BW10	1032.29	1025.89			186.2-196.2	Yes	Stick Up	47.147826	-119.307873
00BW11	1072.87	1073.46			107-117	Yes	Flush Mount	47.188424	-119.317939
00BW12	1077.47				101-111	Yes	Stick Up	47.188245	-119.304851
00BW13	1068.43	1070.73			133-143	Yes	Stick Up	47.165764	-119.301631
00BW14	1084.72				62-72	Yes	Flush Mount	47.191362	-119.288309
00BW15	1073.54	1075.84			105.6-115.6	Yes	Stick Up	47.177595	-119.299711
00BW16	1046.53	1043.97			186.4-196.4	Yes	Stick Up	47.160398	-119.319182
01BW01	1088.09				85-95	Yes	Flush Mount	47.196578	-119.295897
02BW01	1043.69	1141.01*	1037.35	1045.6	188-192.5	Removed	Flush Mount	47.154543	-119.309278
02BW02	1075.1	1077.7			109-118.5	Yes	Flush Mount	47.182746	-119.295425
04BW01	1087.9	1088.07			96-116	No	Stick Up	47.196733	-119.295632
04BW04	1057.2	1057.98			190-210	No	Stick Up	47.186124	-119.331118
04BW05	1062.04	1062.67			176-196	No	Stick Up	47.179966	-119.328492
04BW06	1065.89	1066.43			174-194	No	Stick Up	47.178499	-119.316265
04BW07	1057.26	1057.53			195-215	No	Stick Up	47.164316	-119.313303
04BW09	1068.54	1070.72		1071.05	139.5-149.5	No	Flush Mount	47.16529	-119.303267
04CW01	1034.79	1030.95			298-308	No	Stick Up	47.186125	-119.330888
04CW02	1031.2	1029.59			297-307	No	Stick Up	47.180036	-119.328547
04CW03	1026.02	1012.97			264-284	No	Stick Up	47.180214	-119.311653
04CW04	1057.4	1057.36			303-313	No	Stick Up	47.16437	-119.313331
04CW05	1057.44	1057.44	1055.15	1058.28	260-280	No	Stick Up	47.163731	-119.304417
04CW07	1032.65	1027.16	1015.32	1030.2	283-293/ 303-309	No	Stick Up	47.155184	-119.309159
04CW08	1032.54	1027.59			294-314	No	Flush Mount	47.146414	-119.310925
12BW01	1072.6	1075.05			162 - 172	No	Stick Up	47.168105	-119.301971
12BW02	1051.98	1050.11	1050.11	1055.95	174 - 194	No	Flush Mount	47.156722	-119.305516
12BW03	1058.7	1059.06	1058.66	1061.73	179-189/ 199-219	No	Stick Up	47.160178	-119.312552

Table 3. Monitoring Wells – Groundwater Elevations

Well ID	Water Level Elevation Feb 2016	Water Level Elevation May 2016	Water Level Elevation August 2016	Water Level Elevation August 2016	Screen Interval	Bladder Pump Installed?	Stick Up or Flush Mount	NAD 83 Coordinates	
12BW04	1069.07	1070.43	1071.15	1071.38	158-168/178-188	No	Stick Up	47.165106	-119.307067
12BW05	1069.91	1072.15	1073.63	1072.86	167 - 187	No	Stick Up	47.162973	-119.303437
12BW06	1057.05	1057.18	1056.68	1060.38	170 - 200	No	Flush Mount	47.158669	-119.309139
12BW07	1071.74	1073.73	1075.18	1074.31	160 - 180	No	Stick Up	47.16467	-119.303665
12BW08	1053.08	1052.73	1051.72	1056.77	178 - 198	No	Flush Mount	47.156729	-119.307772
12CW01	1036.42	1031	1018.2	1034.01	274 - 294	No	Flush Mount	47.156724	-119.30559
12CW02	1037.07	1031.54	1018.35	1033.21	300 - 320	No	Stick Up	47.16022	-119.312575
12CW03	1061.51	1061.52	1059.35	1062.29	288-298	No	Stick Up	47.165098	-119.306996
12CW04	1060.34	1060.2	1057.77	1061.23	255 - 265	No	Stick Up	47.16294	-119.303394
12CW05	1036.27	1031.06	1018.31	1033.98	287 - 307	No	Flush Mount	47.158672	-119.309
12EX01	1071.74	1073.85	1075.31	1074.31	160 - 180	No	Stick Up	47.16465	-119.30358
12EX02	1053.03	1052.72	1051.61	1056.72	180 - 198	No	Flush Mount	47.156733	-119.307692
14BW01	1070.04	1071.62	1072.78	1072.47	160-180	No	Stick Up	47.163858	-119.305713
14BW02	1061.57	1062.54	1062.88	1064.8	157-187	No	Stick Up	47.162105	-119.306092
14BW03	1072.14	1074.11	1075.37	1074.46	143-173	No	Stick Up	47.166044	-119.304279
14EX03	1069.74	1071.41	1072.36	1072.18	160-180	No	Stick Up	47.163859	-119.305689
14EX04	1061.64	1062.6	1062.97	1064.87	157-187	No	Stick Up	47.162104	-119.306073
14EX05	1072.18	1064.09	1075.41	1074.42	143-173	No	Stick Up	47.166044	-119.304263
91AW07	1074.41	1075.34			81-101	No	Stick Up	47.180598	-119.311535
91AW09		1075.06		1064.89	81-101	Yes	Stick Up	47.179826	-119.31241
91AW14	1063.56	1064.42			116-136	No	Stick Up	47.188512	-119.327511
91AW15		1072.94			89-109	Yes	Flush Mount	47.188513	-119.317936
91AW17		1071.31			108-128	Yes	Stick Up	47.179675	-119.326143
91BW02	1077.02	1077.9			137-147	Yes	Stick Up	47.192871	-119.315772
91BW03	1073.29	1074.31			170-180	Yes	Stick Up	47.180218	-119.312071
91BW04	1067.08	1068.76		1069.32	178-188	Yes	Stick Up	47.171379	-119.307337
92BW01	1073.77	1075.16		1076.14	143-153	Yes	Stick Up	47.18096	-119.306561
92BW02	1073.74	1075.1		1075.99	147-157	Yes	Stick Up	47.179523	-119.305986
99AW01		1075.3		1075.9	101-111	Yes	Stick Up		
99AW08		1077.37			70-80	Yes	Flush Mount	47.182757	-119.295516
99AW09		1064.13			97.5-107.5	Yes	Stick Up	47.160705	-119.304635
99BW01	1073.31	1074.33			141.5-151.5	Yes	Stick Up	47.180311	-119.311651
99BW09	1033.66	1029.04			110-120	Yes	Stick Up	47.150603	-119.293789
99BW10	1043.56	1041.93		1045.74	175-185	Yes	Flush Mount	47.15475	-119.3095
99BW11	1036.01	1030.7			102-112	Yes	Flush Mount	47.153011	-119.325283
99BW12	1065.44				162-172	Yes	Flush Mount	47.174589	-119.319677
99BW14	1066.98				85-95	Yes	Stick Up	47.16798	-119.294074
99BW15	1074.74				90-100	Yes	Flush Mount	47.182758	-119.295615
99BW16	1063.59	1064.4			146-156	Yes	Stick Up	47.188514	-119.327413
99BW18	1056.01	1056.83		1059.61	143-153	Yes	Stick Up	47.160705	-119.304635

Table 3. Monitoring Wells – Groundwater Elevations

Well ID	Water Level Elevation Feb 2016	Water Level Elevation May 2016	Water Level Elevation August 2016	Water Level Elevation August 2016	Screen Interval	Bladder Pump Installed?	Stick Up or Flush Mount	NAD 83 Coordinates

Notes:

* The groundwater elevation recorded at 02BW01 in May is 100 feet higher then surrounding water levels and other measurements at the well. The water level was not used for the groundwater contour maps.

Table 4. Monitoring and Extraction Wells – Sampling Results

MONITORING AND EXTRACTION WELL RESULTS				CIS-DCE	TCE
Well ID	Sample Name	Sample Date	Sample Type	Results µg/L (MCL 70)	Results µg/L (MCL 5)
Hanford Formation Wells					
00AW11	1605N00AW11	5/21/2016	N	0.20 U	1.32
00AW11	1611N00AW11	11/15/2016	N	0.20 U	1.64
91AW07	1605N91AW07	5/21/2016	N	0.20 U	0.10 J
91AW09	1605N91AW09	5/20/2016	N	0.20 U	0.18 J
91AW14	1605N91AW14	5/18/2016	N	0.20 U	3.94
91AW15	1605N91AW15	5/17/2016	N	0.20 U	0.06 J
91AW17	1605N91AW17	5/19/2016	N	0.20 U	0.15 J
99AW01	1605N99AW01	5/21/2016	N	0.20 U	0.20 U
99AW01	1611N99AW01	11/14/2016	N	0.20 U	0.20 U
99AW08	1605N99AW08	5/20/2016	N	0.20 U	0.16 J
99AW09	1605N99AW09	5/23/2016	N	0.20 U	1.74
99AW09	1611N99AW09	11/15/2016	N	0.20 U	2.38
99AW09	1611D99AW09	11/15/2016	FD	0.20 U	2.13
Priest Rapids/ Roza 1 Wells					
00BW01	1605N00BW01	5/16/2016	N	0.20 U	0.20 U
00BW02	1605N00BW02	5/17/2016	N	0.20 U	0.19 J
00BW03	1605N00BW03	5/17/2016	N	0.20 U	0.20 U
00BW04	1605N00BW04	5/16/2016	N	0.20 U	0.20 U
00BW05	1605N00BW05	5/16/2016	N	0.20 U	0.20 U
00BW05	1605D00BW05	5/16/2016	FD	0.20 U	0.20 U
00BW06	1605N00BW06	5/17/2016	N	0.20 U	0.07 J
00BW07	1605N00BW07	5/17/2016	N	0.20 U	0.20 U
00BW09	1605N00BW09	5/16/2016	N	0.20 U	0.20 U
00BW10	1605N00BW10	5/20/2016	N	0.20 U	0.20 U
00BW11	1605N00BW11	5/17/2016	N	0.20 U	0.20 U
00BW12	1605N00BW12	5/18/2016	N	0.20 U	17.0
00BW13	1605N00BW13	5/22/2016	N	0.20 U	0.20 U
00BW14	1605N00BW14	5/16/2016	N	0.20 U	0.20 U
00BW15	1605N00BW15	5/19/2016	N	0.38	1.97
00BW16	1605N00BW16	5/23/2016	N	0.20 U	0.20 U
00BW16	1605D00BW16	5/23/2016	FD	0.20 U	0.20 U
01BW01	1605N01BW01	5/16/2016	N	0.20 U	0.20 U
02BW01	1602N02BW01	2/24/2016	N	0.20 U	10.9
02BW01	1605N02BW01	5/20/2016	N	0.20 U	10.7
02BW01	1605D02BW01	5/20/2016	FD	0.20 U	9.99
02BW01	1611N02BW01	11/17/2016	N	0.20 U	11.1
02BW02	1605N02BW02	5/20/2016	N	0.20 U	0.07 J

Table 4. Monitoring and Extraction Wells – Sampling Results

MONITORING AND EXTRACTION WELL RESULTS				CIS-DCE	TCE
Well ID	Sample Name	Sample Date	Sample Type	Results µg/L (MCL 70)	Results µg/L (MCL 5)
04BW01	1605N04BW01	5/16/2016	N	0.20 U	0.20 U
04BW04	1605N04BW04	5/18/2016	N	0.20 U	0.30
04BW05	1605N04BW05	5/19/2016	N	0.10 J	2.66
04BW06	1605N04BW06	5/20/2016	N	2.74	13.2
04BW07	1605N04BW07	5/22/2016	N	0.20 U	0.20 U
04BW09	1602N04BW09	2/24/2016	N	0.20 U	21.8
04BW09	1605N04BW09	5/22/2016	N	0.20 U	20.1
04BW09	1611N04BW09	11/16/2016	N	0.20 U	24.0
12BW01	1605N12BW01	5/22/2016	N	0.20 U	0.20 U
12BW02	1602N12BW02	2/22/2016	N	0.20 U	8.45
12BW02	1605N12BW02	5/20/2016	N	0.20 U	7.77
12BW02	1611N12BW02	11/17/2016	N	0.20 U	7.89
12BW03	1602N12BW03A	2/23/2016	N	0.20 U	1.62
12BW03	1602N12BW03B	2/23/2016	N	0.20 U	0.65
12BW03	1605N12BW03A	5/22/2016	N	0.20 U	0.94
12BW03	1605N12BW03B	5/22/2016	N	0.20 U	0.51
12BW03	1611N12BW03A	11/17/2016	N	0.20 U	0.61
12BW03	1611N12BW03B	11/17/2016	N	0.20 U	0.47
12BW04	1602N12BW04A	2/24/2016	N	0.20 U	18.2
12BW04	1602N12BW04B	2/24/2016	N	0.20 U	19.0
12BW04	1605N12BW05	5/22/2016	N	0.20 U	85.5
12BW04	1605N12BW04A	5/22/2016	N	0.20 U	17.3
12BW04	1605N12BW04B	5/22/2016	N	0.20 U	20.2
12BW04	1611N12BW04A	11/16/2016	N	0.20 U	20.8
12BW04	1611N12BW04B	11/16/2016	N	0.20 U	20.6
12BW05	1602N12BW05	2/24/2016	N	0.20 U	79.9
12BW05	1611N12BW05	11/16/2016	N	0.20 U	92.2
12BW06	1602N12BW06	2/23/2016	N	0.20 U	6.73
12BW06	1602D12BW06	2/23/2016	FD	0.20 U	6.28
12BW06	1605N12BW06	5/23/2016	N	0.20 U	4.84
12BW06	1611N12BW06	11/17/2016	N	0.20 U	6.20
12BW06	1611D12BW06	11/17/2016	FD	0.20 U	5.91
12BW07	1602N12BW07	2/24/2016	N	0.20 U	63.8
12BW07	1605N12BW07	5/19/2016	N	0.20 U	75.3
12BW07	1611N12BW07	11/16/2016	N	0.20 U	71.0
12BW08	1602N12BW08	2/22/2016	N	0.20 U	9.38
12BW08	1605N12BW08	5/23/2016	N	0.20 U	7.45
12BW08	1611N12BW08	11/17/2016	N	0.20 U	8.87
14BW01	1602N14BW01	2/23/2016	N	0.20 U	59.0

Table 4. Monitoring and Extraction Wells – Sampling Results

MONITORING AND EXTRACTION WELL RESULTS				CIS-DCE	TCE
Well ID	Sample Name	Sample Date	Sample Type	Results µg/L (MCL 70)	Results µg/L (MCL 5)
14BW01	1605N14BW01	5/19/2016	N	0.20 U	68.3
14BW01	1611N14BW01	11/17/2016	N	0.20 U	59.5
14BW01	1611D14BW01	11/17/2016	FD	0.20 U	59.1
14BW02	1602N14BW02	2/23/2016	N	0.20 U	22.2
14BW02	1605N14BW02	5/22/2016	N	0.20 U	21.9
14BW02	1611N14BW02	11/17/2016	N	0.20 U	20.5
14BW03	1602N14BW03	2/24/2016	N	0.20 U	9.35
14BW03	1602D14BW03	2/24/2016	FD	0.20 U	9.11
14BW03	1605N14BW03	5/22/2016	N	0.20 U	9.17
14BW03	1611N14BW03	11/16/2016	N	0.20 U	9.98
91BW02	1605N91BW02	5/17/2016	N	0.20 U	0.20 U
91BW03	1605N91BW03	5/20/2016	N	0.20 U	26.6
91BW04	1602N91BW04	2/23/2016	N	0.20 U	0.24
91BW04	1605N91BW04	5/22/2016	N	0.20 U	0.15 J
91BW04	1611N91BW04	11/15/2016	N	0.20 U	0.20 U
92BW01	1602N92BW01	2/23/2016	N	0.20 U	25.6
92BW01	1602D92BW01	2/23/2016	FD	0.20 U	25.3
92BW01	1605N92BW01	5/21/2016	N	0.20 U	21.0
92BW01	1605D92BW01	5/21/2016	FD	0.20 U	21.8
92BW01	1611N92BW01	11/15/2016	N	0.20 U	21.9
92BW02	1605N92BW02	5/21/2016	N	0.74	7.27
92BW02	1611N92BW02	11/15/2016	N	0.87	8.21
99BW01	1605N99BW01	5/19/2016	N	0.20 U	32.2
99BW09	1605N99BW09	5/21/2016	N	0.20 U	0.20 U
99BW10	1602N99BW10	2/23/2016	N	0.20 U	14.9
99BW10	1605N99BW10	5/23/2016	N	0.20 U	12.0
99BW10	1611N99BW10	11/15/2016	N	0.20 U	12.0
99BW11	1605N99BW11	5/23/2016	N	0.20 U	0.20 U
99BW12	1605N99BW12	5/19/2016	N	0.20 U	0.20 U
99BW12	1605D99BW12	5/19/2016	FD	0.20 U	0.20 U
99BW14	1605N99BW14	5/21/2016	N	0.20 U	0.20 U
99BW15	1605N99BW15	5/18/2016	N	1.71	7.16
99BW16	1605N99BW16	5/18/2016	N	0.20 U	1.14
99BW18	1602N99BW18	2/23/2016	N	0.20 U	9.12
99BW18	1605N99BW18	5/23/2016	N	0.20 U	6.49
99BW18	1611N99BW18	11/15/2016	N	0.20 U	6.62
Roza 2 Wells					
04CW01	1605N04CW01	5/18/2016	N	0.20 U	0.44
04CW01	1605D04CW01	5/18/2016	FD	0.20 U	0.48

Table 4. Monitoring and Extraction Wells – Sampling Results

MONITORING AND EXTRACTION WELL RESULTS				CIS-DCE	TCE
Well ID	Sample Name	Sample Date	Sample Type	Results µg/L (MCL 70)	Results µg/L (MCL 5)
04CW02	1605N04CW02	5/19/2016	N	0.20 U	0.06 J
04CW03	1605N04CW03	5/21/2016	N	0.20 U	2.05
04CW04	1605N04CW04	5/22/2016	N	0.20 U	0.40
04CW05	1602N04CW05	2/24/2016	N	0.20 U	2.38
04CW05	1605N04CW05	5/22/2016	N	0.20 U	2.41
04CW05	1605D04CW05	5/22/2016	FD	0.20 U	2.07
04CW05	1611N04CW05	11/16/2016	N	0.20 U	2.25
04CW07	1602N04CW07A	2/24/2016	N	0.20 U	5.52
04CW07	1602N04CW07B	2/24/2016	N	0.20 U	5.73
04CW07	1605N04CW07A	5/23/2016	N	0.20 U	6.01
04CW07	1605N04CW07B	5/23/2016	N	0.20 U	5.66
04CW07	1611N04CW07A	11/17/2016	N	0.20 U	5.79
04CW07	1611N04CW07B	11/17/2016	N	0.20 U	6.10
04CW08	1605N04CW08	5/23/2016	N	0.20 U	0.20 U
12CW01	1602N12CW01	2/22/2016	N	0.20 U	3.74
12CW01	1605N12CW01	5/23/2016	N	0.20 U	3.16
12CW01	1611N12CW01	11/17/2016	N	0.20 U	3.61
12CW02	1602N12CW02	2/23/2016	N	0.20 U	0.37
12CW02	1605N12CW02	5/22/2016	N	0.20 U	0.33
12CW02	1611N12CW02	11/17/2016	N	0.20 U	0.20 U
12CW03	1602N12CW03	2/24/2016	N	0.20 U	0.28
12CW03	1605N12CW03	5/22/2016	N	0.20 U	0.31
12CW03	1611N12CW03	11/16/2016	N	0.20 U	0.20 U
12CW04	1602N12CW04	2/24/2016	N	0.20 U	0.51
12CW04	1605N12CW04	5/22/2016	N	0.20 U	0.44
12CW04	1611N12CW04	11/16/2016	N	0.20 U	0.52
12CW05	1602N12CW05	2/23/2016	N	0.20 U	0.80
12CW05	1605N12CW05	5/23/2016	N	0.20 U	0.65
12CW05	1611N12CW05	11/17/2016	N	0.20 U	0.62
Extraction Wells					
12EX01	1602N12EX01	2/24/2016	N	0.27	6.58
12EX01	1605N12EX01	5/22/2016	N	0.28	5.46
12EX01	1611N12EX01	11/16/2016	N	0.18 J	4.21
12EX02	1602N12EX02	2/22/2016	N	0.20 U	4.81
12EX02	1605N12EX02	5/23/2016	N	0.20 U	5.02
12EX02	1611N12EX02	11/17/2016	N	0.20 U	4.47
14EX03	1602N14EX03	2/23/2016	N	0.35	32.4
14EX03	1605N14EX03	5/22/2016	N	0.34	35.4
14EX03	1605D14EX03	5/22/2016	FD	0.36	37.3

Table 4. Monitoring and Extraction Wells – Sampling Results

MONITORING AND EXTRACTION WELL RESULTS				CIS-DCE	TCE
Well ID	Sample Name	Sample Date	Sample Type	Results µg/L (MCL 70)	Results µg/L (MCL 5)
14EX03	1611N14EX03	11/16/2016	N	0.40	35.4
14EX04	1602N14EX04	2/23/2016	N	0.20 U	18.7
14EX04	1605N14EX04	5/22/2016	N	0.20 U	17.2
14EX04	1611N14EX04	11/17/2016	N	0.20 U	16.5
14EX05	1602N14EX05	2/24/2016	N	0.15 J	3.61
14EX05	1605N14EX05	5/22/2016	N	0.13 J	3.67
14EX05	1611N14EX05	11/16/2016	N	0.13 J	4.57

Cells shaded red exceed 5.0 µg/L TCE MCL risk level.

N -Normal Sample
FD -Field Duplicate
U -Undetected
J -Estimated
MCL-Maximum Contaminant Level

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Table 5. Perfluorinated Alkyl Acids and 1,4-Dioxane in Select Monitoring Wells

				PFOS	PFOA	PFOS+ PFOA	PFHpA	PFNA	PFBS	PFHxS	1,4 Dioxane
Well ID	Sample ID	Date	Sample Type	0.2 µg/L (provisional health advisory)	0.4 µg/L (provisional health advisory)	0.07 µg/L (EPA health advisory) combined LOQ=0.06		0.013 µg/L (New Jersey DOH requested as MCL)	380 µg/L (MCL)		0.67 µg/L*
Monitoring Wells											
Hanford Formation Wells											
91AW14	1605N91AW14	5/18/2016	N	0.119	0.143	0.262	0.0196	0.0592	0.0765	0.395	
Priest Rapids/ Roza 1 Wells											
00BW10	1605N00BW10	5/20/2016	N								0.03 J
00BW12	1605N00BW12	5/18/2016	N								0.09
00BW15	1605N00BW15	5/19/2016	N								0.06 U
02BW01	1605N02BW01	5/20/2016	N								0.06 U
04BW04	1605N04BW04	5/18/2016	N	0.0112 J	0.00627 J	0.01747	0.00262 J	0.0200 U	0.0900 U	0.0217 J	
04BW05	1605N04BW05	5/19/2016	N								0.06 U
12BW02	1605N12BW02	5/20/2016	N								0.06 U
12BW07	1605N12BW07	5/19/2016	N								0.06 U
14BW01	1605N14BW01	5/19/2016	N								0.06 U
99BW01	1605N99BW01	5/19/2016	N								0.1
99BW12	1605N99BW12	5/19/2016	N								0.05 J
99BW15	1605N99BW15	5/18/2016	N								0.25
99BW16	1605N99BW16	5/18/2016	N	0.348	0.336	0.684	0.0427	0.0201	0.162	0.718	0.03
Roza 2 Wells											
04CW01	1605N04CW01	5/18/2016	N	0.052	0.105	0.157	0.0169	0.0200 U	0.0318 J	0.252	
04CW01	1605D04CW01	5/18/2016	FD	0.0711	0.14	0.2111	0.0215	0.0200 U	0.0423 J	0.334	

Table 5. Perfluorinated Alkyl Acids and 1,4-Dioxane in Select Monitoring Wells

				PFOS	PFOA	PFOS+ PFOA	PFHpA	PFNA	PFBS	PFHxS	1,4 Dioxane
Well ID	Sample ID	Date	Sample Type	0.2 µg/L (provisional health advisory)	0.4 µg/L (provisional health advisory)	0.07 µg/L (EPA health advisory) combined LOQ=0.06		0.013 µg/L (New Jersey DOH requested as MCL)	380 µg/L (MCL)		0.67 µg/L*
Field Blanks: Monitoring Wells											
FB0191AW14	1605FB0191AW14	5/18/2016	FB	0.0400U	0.0200 U		0.0100 U	0.0200 U	0.0900 U	0.0300 U	
FB0299BW16	1605FB0299BW16	5/18/2016	FB	0.0400U	0.0200 U		0.0100 U	0.0200 U	0.0900 U	0.0300 U	
FB0304BW04	1605FB0304BW04	5/18/2016	FB	0.0400U	0.0200 U		0.0100 U	0.0200 U	0.0900 U	0.0300 U	
FB0404CW01	1605FB0404CW01	5/18/2016	FB	0.0400U	0.0200 U		0.0100 U	0.0200 U	0.0900 U	0.0300 U	
Private Wells											
WP-168	16051605NWP168	5/18/2016	N								0.06 U
WP-119A1	1605NWP119A1	5/17/2016	N	0.0400U	0.0200 U		0.0100 U	0.0200 U	0.0900 U	0.0300 U	
WP-119C1	1605NWP119C1	5/17/2016	N	0.0400U	0.0200 U		0.0100 U	0.0200 U	0.0900 U	0.0300 U	
WP-121A1	1605NWP121A1	5/17/2016	N	0.0400U	0.0200 U		0.0100 U	0.0200 U	0.0900 U	0.00442 J	0.06 U
WP-121C1	1605NWP121C1	5/17/2016	N	0.0400U	0.0200 U		0.0100 U	0.0200 U	0.0900 U	0.0300 U	
WP-124A1	1605NWP124A1	5/18/2016	N	0.0400U	0.0200 U		0.0100 U	0.0200 U	0.0900 U	0.0300 U	
WP-124C1	1605NWP124C1	5/18/2016	N	0.0400U	0.0200 U		0.0100 U	0.0200 U	0.0900 U	0.0300 U	
WP-125A1	1605NWP125A1	5/17/2016	N	0.0400U	0.0200 U		0.0100 U	0.0200 U	0.0900 U	0.0300 U	0.06 U
WP-125C1	1605NWP125C1	5/17/2016	N	0.0400U	0.0200 U		0.0100 U	0.0200 U	0.0900 U	0.0300 U	
WP-144	1605NWP144	5/18/2016	N								0.04 J
WP-45	1605NWP45	5/18/2016	N								0.06 U
WP-52	1605NWP52	5/18/2016	N								0.06 U
WP-69	1605NWP69	5/18/2016	N								0.06 U
WP-74	1605NWP74	5/18/2016	N								0.06 U
Field Blanks: Private Wells											

Table 5. Perfluorinated Alkyl Acids and 1,4-Dioxane in Select Monitoring Wells

				PFOS	PFOA	PFOS+ PFOA	PFHpA	PFNA	PFBS	PFHxS	1,4 Dioxane
Well ID	Sample ID	Date	Sample Type	0.2 µg/L (provisional health advisory)	0.4 µg/L (provisional health advisory)	0.07 µg/L (EPA health advisory) combined LOQ=0.06		0.013 µg/L (New Jersey DOH requested as MCL)	380 µg/L (MCL)		0.67 µg/L*
WP-119	1605FBWP119	5/17/2016	FB	0.0400U	0.0200 U		0.0100 U	0.0200 U	0.0900 U	0.0300 U	
WP-121	1605FBWP121	5/17/2016	FB	0.0400U	0.0200 U		0.0100 U	0.0200 U	0.0900 U	0.0300 U	
WP-124	1605FBWP124	5/18/2016	FB	0.0400U	0.0200 U		0.0100 U	0.0200 U	0.0900 U	0.0300 U	
WP-125	1605FBWP125	5/17/2016	FB	0.0400U	0.0200 U		0.0100 U	0.0200 U	0.0900 U	0.0300 U	

* EPA has calculated a screening level of 0.67 µg/L for 1,4-dioxane in tap water based on a 1 in 1,000,0000 lifetime excess cancer risk (EPA 2013c).

Yellow = exceedance

PFBS Perfluorobutanesulfonic Acid

PFHpA Perfluoroheptanoic Acid

PFHxS Perfluorohexanesulfonic Acid

PFNA Perfluorononanoic Acid

PFOS Perfluorooctanesulfonic Acid

PFOA Perfluorooctanoic Acid

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Table 6. Private Wells without WHFs – Sampling Results

PRIVATE WELL WITHOUT WHF - RESULTS				CIS-DCE	TCE
Well ID	Sample Name	Sample Date	Sample Type	Results µg/L (MCL 70)	Results µg/L (MCL 5)
WP-03	1605DWP03	5/16/2016	FD	0.23	1.06
WP-03	1605NWP03	5/16/2016	N	0.23	1.16
WP-04	1602NWP04	2/22/2016	N	2.08	6.14
WP-04	1605NWP04	5/17/2016	N	2.09	6.23
WP-04	1608NWP04	8/17/2016	N	1.89	5.84
WP-04	1611NWP04	11/16/2016	N	1.98	5.92
WP-09	1605NWP09	5/17/2016	N	0.20 U	0.20 U
WP-10	1605NWP10	5/16/2016	N	0.20 U	0.20 U
WP-105	1605NWP105	5/16/2016	N	0.20 U	0.45
WP-111	1605NWP111	5/18/2016	N	0.20 U	0.22
WP-111	1605DWP111	5/18/2016	FD	0.20 U	0.20
WP-116	1605NWP116	5/16/2016	N	0.46	1.92
WP-120	1605NWP120	5/16/2016	N	0.20 U	0.35
WP-122	1605NWP122	5/16/2016	N	0.20 U	0.17 J
WP-126	1605NWP126	5/16/2016	N	0.14 J	0.99
WP-127	1605NWP127	5/16/2016	N	0.20 U	0.89
WP-128	1605NWP128	5/17/2016	N	0.20 U	0.42
WP-130	1605NWP130	5/16/2016	N	0.20 U	0.45
WP-131	1602NWP131	2/24/2016	N	0.20 U	0.88
WP-131	1605NWP131	5/17/2016	N	0.11 J	3.12
WP-131	1608NWP131	8/17/2016	N	0.20 U	1.69
WP-131	1611NWP131	11/16/2016	N	0.20 U	1.30
WP-136	1605NWP136	5/16/2016	N	0.20 U	1.19
WP-137	1605NWP137	5/17/2016	N	0.20 U	1.31
WP-138	1605NWP138	5/16/2016	N	0.20 U	0.55
WP-139	1605NWP139	5/16/2016	N	0.20 U	0.80
WP-143	1605NWP143	5/17/2016	N	0.20 U	0.57
WP-144	1605NWP144	5/18/2016	N	0.20 U	0.25
WP-145	1605NWP145	5/16/2016	N	0.20 U	0.32
WP-147	1605NWP147	5/17/2016	N	0.20 U	0.16 J
WP-148	1605NWP148	5/18/2016	N	0.20 U	0.16 J
WP-149	1605NWP149	5/17/2016	N	0.20 U	0.07 J
WP-150	1605NWP150	5/17/2016	N	0.20 U	0.08 J
WP-152	1605NWP152	5/16/2016	N	0.20 U	0.20
WP-153	1605NWP153	5/18/2016	N	0.20 U	0.26
WP-153	1605DWP153	5/18/2016	FD	0.20 U	0.25
WP-154	1605NWP154	5/18/2016	N	0.20 U	0.29
WP-155	1605NWP155	5/16/2016	N	0.20 U	0.29
WP-156	1605NWP156	5/16/2016	N	0.20 U	0.38

Table 6. Private Wells without WHFs – Sampling Results

PRIVATE WELL WITHOUT WHF - RESULTS				CIS-DCE	TCE
Well ID	Sample Name	Sample Date	Sample Type	Results µg/L (MCL 70)	Results µg/L (MCL 5)
WP-165	1605NWP165	5/16/2016	N	0.20 U	0.16 J
WP-167	1602NWP167	2/23/2016	N	0.20 U	1.35
WP-167	1605NWP167	5/16/2016	N	0.20 U	2.21
WP-167	1608NWP167	8/17/2016	N	0.20 U	2.17
WP-167	1611NWP167	11/16/2016	N	0.20 U	1.80
WP-168	1602NWP168	2/23/2016	N	0.20 U	2.04
WP-168	1605NWP168	5/16/2016	N	0.20 U	2.04
WP-168	1605DWP168	5/16/2016	FD	0.20 U	2.47
WP-168	1608NWP168	8/17/2016	N	0.20 U	2.26
WP-168	1611NWP168	11/16/2016	N	0.20 U	2.47
WP-169	1605NWP169	5/16/2016	N	0.20 U	1.51
WP-170	1605NWP170	5/18/2016	N	0.20 U	0.71
WP-171	1605NWP171	5/18/2016	N	0.20 U	0.20 U
WP-172	1605NWP172	5/16/2016	N	0.20 U	0.47
WP-173	1605NWP173	5/18/2016	N	0.20 U	0.20 U
WP-177	1605NWP177	5/16/2016	N	0.20 U	0.07 J
WP-178	1605NWP178	5/16/2016	N	0.20 U	0.21
WP-179	1605NWP179	5/16/2016	N	0.20 U	0.09 J
WP-180	1605NWP180	5/18/2016	N	0.20 U	0.06 J
WP-27	1602NWP27	2/24/2016	N	0.20 U	1.36
WP-27	1602DWP27	2/24/2016	FD	0.20 U	1.34
WP-27	1605NWP27	5/17/2016	N	0.20 U	1.66
WP-27	1608NWP27	8/16/2016	N	0.20 U	1.56
WP-27	1611NWP27	11/15/2016	N	0.20 U	1.25
WP-27	1611DWP27	11/15/2016	FD	0.20 U	1.43
WP-28	1605NWP28	5/17/2016	N	0.20 U	1.57
WP-33	1605NWP33	5/18/2016	N	0.20 U	0.60
WP-45	1605NWP45	5/18/2016	N	0.20 U	0.70
WP-45	1605DWP45	5/18/2016	FD	0.20 U	0.73
WP-50	1605NWP50	5/17/2016	N	0.20 U	0.20 U
WP-52	1605NWP52	5/17/2016	N	0.20 U	0.17 J
WP-52	1605DWP52	5/17/2016	FD	0.20 U	0.19 J
WP-54	1605NWP54	5/17/2016	N	0.20 U	0.20 U
WP-57	1605NWP57	5/18/2016	N	0.20 U	0.41
WP-57	1605DWP57	5/18/2016	FD	0.20 U	0.44
WP-65	1605NWP65	5/16/2016	N	0.20 U	0.38
WP-66	1605NWP66	5/16/2016	N	0.35	1.52
WP-68	1605NWP68	5/16/2016	N	0.20 U	0.59
WP-69	1605DWP69	5/18/2016	FD	0.18 J	1.57
WP-69	1605NWP69	5/18/2016	N	0.18 J	1.54
WP-71A	1605NWP71A	5/18/2016	N	0.20 U	0.18 J

Table 6. Private Wells without WHFs – Sampling Results

PRIVATE WELL WITHOUT WHF - RESULTS				CIS-DCE	TCE
Well ID	Sample Name	Sample Date	Sample Type	Results µg/L (MCL 70)	Results µg/L (MCL 5)
WP-71B	1605NWP71B	5/18/2016	N	0.20 U	0.40
WP-74	1605NWP74	5/18/2016	N	0.21	1.13
WP-82	1605NWP82	5/17/2016	N	0.20 U	0.09 J

	Cell shaded yellow - exceeded 2.0 µg/L TCE in 2013 and has been sampled quarterly since
	Cells shaded red - exceeded 5.0 µg/L TCE MCL risk level. This well does not have a WHF system because water is used for industrial purposes only.

N -Normal Sample
FD -Field Duplicate
U -Undetected
J -Estimated
MCL-Maximum Contaminant Level

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Table 7. Private Wells with WHFs- Analytical Results

NOTE: Mid and effluent results in all cases were <0.20 µg/L for cis-DCE and TCE and therefore are not shown.

PRIVATE WHF WELL RESULTS					cis-DCE	TCE
Well ID	Sample Name	Sample Date	Sample Type	Sample Location	Results µg/L (MCL 70)	Results µg/L (MCL 5)
WP-119	1602NWP119A1	2/24/2016	N	Influent	0.16 J	2.92
WP-119	1605NWP119A1	5/17/2016	N	Influent	0.18 J	3.54
WP-119	1605DWP119A1	5/17/2016	FD	Influent	0.18 J	3.76
WP-119	1608NWP119A1	8/17/2016	N	Influent	0.17 J	3.57
WP-119	1611NWP119A1	11/16/2016	N	Influent	0.25	3.02
WP-119	1611NWP119B1	11/16/2016	N	Mid	0.20 U	0.20 U
WP-119	1611NWP119C1	11/16/2016	N	Effluent	0.20 U	0.20 U
WP-121	1602NWP121A1	2/24/2016	N	Influent	0.14 J	3.16
WP-121	1602DWP121A1	2/24/2016	FD	Influent	0.12 J	3.32
WP-121	1605NWP121A1	5/17/2016	N	Influent	0.17 J	4.06
WP-121	1608NWP121A1	8/17/2016	N	Influent	0.15 J	4.23
WP-121	1611NWP121A1	11/16/2016	N	Influent	0.15 J	3.34
WP-121	1611NWP121B1	11/16/2016	N	Mid	0.20 U	0.20 U
WP-121	1611NWP121C1	11/16/2016	N	Effluent	0.20 U	0.20 U
WP-123	1602NWP123A1	2/24/2016	N	Influent	0.30	2.21
WP-123	1605NWP123A1	5/16/2016	N	Influent	0.26	3.71
WP-123	1608NWP123A1	8/17/2016	N	Influent	0.17 J	3.14
WP-123	1611NWP123A1	11/16/2016	N	Influent	0.49	2.77
WP-123	1611NWP123B1	11/16/2016	N	Mid	0.20 U	0.20 U
WP-123	1611DWP123B1	11/16/2016	FD	Mid	0.20 U	0.20 U
WP-123	1611NWP123C1	11/16/2016	N	Effluent	0.20 U	0.20 U
WP-124	1602NWP124A1	2/24/2016	N	Influent	1.00	3.83
WP-124	1605NWP124A1	5/18/2016	N	Influent	0.88	3.87
WP-124	1608NWP124A1	8/17/2016	N	Influent	0.93	4.03
WP-124	1611NWP124A1	11/15/2016	N	Influent	1.45	4.85
WP-125	1602NWP125A1	2/24/2016	N	Influent	0.76	2.95
WP-125	1602NWP125B1	2/24/2016	N	Mid	0.20 U	0.20 U
WP-125	1602NWP125C1	2/24/2016	N	Effluent	0.20 U	0.20 U
WP-125	1605NWP125A1	5/17/2016	N	Influent	0.92	3.70
WP-125	1605NWP125B1	5/17/2016	N	Mid	0.20 U	0.20 U
WP-125	1605NWP125C1	5/17/2016	N	Effluent	0.20 U	0.20 U
WP-125	1608NWP125A1	8/17/2016	N	Influent	0.73	3.44
WP-125	1611NWP125A1	11/15/2016	N	Influent	1.02	3.98
WP-129	1602NWP129A1	2/24/2016	N	Influent	0.20 U	3.13
WP-129	1605NWP129A1	5/16/2016	N	Influent	0.11 J	3.12
WP-129	1608NWP129A1	8/17/2016	N	Influent	0.20 U	1.46
WP-129	1611NWP129A1	11/15/2016	N	Influent	0.11 J	3.39
WP-14	1602NWP14A1	2/23/2016	N	Influent	0.71	2.85

Table 7. Private Wells with WHFs- Analytical Results

PRIVATE WHF WELL RESULTS					cis-DCE	TCE
Well ID	Sample Name	Sample Date	Sample Type	Sample Location	Results µg/L (MCL 70)	Results µg/L (MCL 5)
WP-14	1605NWP14A1	5/18/2016	N	Influent	0.85	3.22
WP-14	1605NWP14B1	5/18/2016	N	Mid	0.20 U	0.20 U
WP-14	1605NWP14C1	5/18/2016	N	Effluent	0.20 U	0.20 U
WP-14	1608NWP14A1	8/17/2016	N	Influent	0.85	3.14
WP-14	1608DWP14A1	8/17/2016	FD	Influent	0.92	3.45
WP-14	1611NWP14A1	11/16/2016	N	Influent	0.89	3.11
WP-70	1602NWP70A1	2/24/2016	N	Influent	0.19 J	3.06
WP-70	1605NWP70A1	5/16/2016	N	Influent	0.23	2.98
WP-70	1605NWP70B1	5/16/2016	N	Mid	0.20 U	0.20 U
WP-70	1605NWP70C1	5/16/2016	N	Effluent	0.20 U	0.20 U
WP-70	1608NWP70A1	8/17/2016	N	Influent	0.20 J	3.66
WP-70	1608DWP70A1	8/17/2016	FD	Influent	0.23	3.89
WP-70	1611NWP70A1	11/15/2016	N	Influent	0.29	3.52
WP-83	1602NWP83A1	2/23/2016	N	Influent	0.24	1.28
WP-83	1605NWP83A1	5/17/2016	N	Influent	0.23	1.05
WP-83	1605NWP83B1	5/17/2016	N	Mid	0.20 U	0.20 U
WP-83	1605NWP83C1	5/17/2016	N	Effluent	0.20 U	0.20 U
WP-83	1608NWP83A1	8/17/2016	N	Influent	0.22	1.05
WP-83	1611NWP83A1	11/16/2016	N	Influent	0.29	1.12
WP-86	1602NWP86A1	2/23/2016	N	Influent	0.20 U	2.31
WP-86	1605NWP86A1	5/17/2016	N	Influent	0.20 U	2.13
WP-86	1605NWP86B1	5/17/2016	N	Mid	0.20 U	0.20 U
WP-86	1605NWP86C1	5/17/2016	N	Effluent	0.20 U	0.20 U
WP-86	1608NWP86A1	8/17/2016	N	Influent	0.20 U	1.03
WP-86	1611NWP86A1	11/16/2016	N	Influent	0.20 U	2.07

Sample ID locations are as follows:

A-influent before lead, B- in between lead and lag filter (mid), C - effluent after lag

N -Normal Sample

FD -Field Duplicate

U -Undetected

J -Estimated

Table 8. Whole House Filters – Purge and Totalizer Volume Summary

Date	Well System	Flow Meter Initial (Gal)	Flow Meter Final (Gal)
February 2016 Sampling Event			
2/24/2016	WP-70	223,044	223,049
2/23/2016	WP-86	537,667	537,672
2/23/2016	WP-83	1,831,332	1,831,337
2/23/2016	WP-14	1,570,451	1,570,457
2/24/2016	WP-119	178,083	178,088
2/24/2016	WP-121	63,276	63,283
2/24/2016	WP-124	256,683	256,687
2/24/2016	WP-129	99,970	99,987
2/24/2016	WP-123	187,865	187,871
2/24/2016	WP-125	332,048	332,053
May 2016 Sampling Event			
5/16/2016	WP-70	237,065	237,068
5/17/2016	WP-86	577,204	577,208
5/18/2016	WP-83	1,929,404	1,929,408
5/18/2016	WP-14	1,728,251	1,728,256
5/17/2016	WP-119	188,096	188,105
5/17/2016	WP-121	68,690	68,695
5/18/2016	WP-124	275,513	275,518
5/16/2016	WP-129	120,800	120,806
5/16/2016	WP-123	204,680	204,685
5/17/2016	WP-125	449,538	449,543
August 2016 Sampling Event			
8/17/2016	WP-70	250,430	250,435
8/17/2016	WP-86	654,355	654,360
8/17/2016	WP-83	2,214,585	2,214,595
8/17/2016	WP-14	1,989,093	1,989,118
8/17/2016	WP-119	204,951	204,961
8/17/2016	WP-121	78,101	78,116
8/17/2016	WP-124	292,767	292,772
8/17/2016	WP-129	162,733	162,733
8/17/2016	WP-123	278,623	278,633
8/17/2016	WP-125	562,451	562,456
November 2016 Sampling Event			
11/15/2016	WP-70	267,749	267,759
11/16/2016	WP-86	729,764	729,772
11/16/2016	WP-83	2,367,352	2,367,362
11/16/2016	WP-14	2,159,369	2,159,384
11/16/2016	WP-119	216,945	216,955
11/15/2016	WP-121	83,563	83,568
11/15/2016	WP-124	313,180	313,190
11/15/2016	WP-129	183,660	183,625

Table 8. Whole House Filters – Purge and Totalizer Volume Summary

Date	Well System	Flow Meter Initial (Gal)	Flow Meter Final (Gal)
11/16/2016	WP-123	305,983	305,996
11/15/2016	WP-125	634,562	634,565

APPENDIX A - Field Sampling Reports (CD only)

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Private Wells and Monitoring Wells Groundwater Sampling Field Report

February 2016 Field Sampling Event

Moses Lake Wellfield Superfund Site
Moses Lake, Washington

(b) (6)

Field Investigation:
22-25 February 2016
Report Prepared:
March 2016

By: Technical Services Branch

US Army Corps of Engineers ®
Seattle District

TABLE OF CONTENTS

APPENDICES

1.0 BACKGROUND AND OBJECTIVE OF INVESTIGATION

1.1 BACKGROUND

The Moses Lake Wellfield Superfund Site is located between the Grant County Airport and the City of Moses Lake, Washington. The Site includes the former Larson Air Force Base (LAFB) property, Port of Moses Lake property and adjacent private properties affected by Site groundwater contamination. The Site is listed on the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980 National Priorities List (NPL) for Uncontrolled Hazardous Waste Sites.

The Moses Lake Wellfield Superfund Site is an area of approximately 15 square miles, which includes the former LAFB, commercial facilities, and residences. The former LAFB occupied approximately 9,607 acres three miles northwest of the City of Moses Lake. The United States Air Force was active at the site from 1942 until 1966. During 1988 and 1989, the Washington State Department of Health confirmed the presence of trichloroethylene (TCE) above the Federal Maximum Contaminant Level (MCL) in three City of Moses Lake municipal wells and two Skyline community wells. The Seattle District, US Army Corps of Engineers (USACE) completed a Remedial Investigation (RI) phase in 2003. Appendix A of this report shows the general location map and a site map.

During the course of the RI, several private wells were tested and found to be contaminated with TCE. In 2001, the USACE contracted installation of carbon filtration units – known as whole house filter systems (WHF) - at five of those wells. Several years of groundwater monitoring data has been evaluated since the original WHF systems were installed.

The final results of the Phase I RI released in a report in March 1993 indicated that TCE was consistently found in shallow alluvial and upper basalt (*a*-basalt) groundwater in the central area of the former base.

On October 14, 1992, the affected areas of the former LAFB and off-site down gradient areas, termed the "Moses Lake Wellfield Contamination", were listed on the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) of 1980 for Uncontrolled Hazardous Waste Sites. The former LAFB property is one part of the Moses Lake Wellfield Superfund Site; the site also includes the contaminant plume.

Chemical results from 1993 and 1994 combined with historical data indicated that TCE occurred in the central and southern portion of the former LAFB in alluvial and *a*-basalt groundwater. In 2004, USACE confirmed TCE contamination in the next lower basalt aquifer (c-basalt). As of 1995, the data suggest that more than one source may have contributed TCE to the alluvial and *a*-basalt groundwater in the central portion of the former LAFB.

In 1998, URS Greiner completed a sampling round of private water wells and wells for Class A and Class B water systems east, south and southwest of the previously known TCE plume. There were eight detections of TCE during this study. Four wells that were previously outside the plume extent were found to be above the detection limit.

1.2 Groundwater Sampling Event Summary and Objectives

In coordination with the US Environmental Protection Agency (USEPA) Region 10, two USACE environmental field teams deployed to conduct the February 2016 Moses Lake Wellfield groundwater sampling event during a single mobilization. The events described in this report involve USACE field teams verifying sample point locations; discussion of sampling techniques; recording groundwater observations; collecting groundwater samples; and shipping those samples by overnight delivery for laboratory analysis. Environmental sampling team members responsible for the February 2016 field event were Joseph Marsh, Matthew Brookshier, Karah Haskins, and Jacob Williams.

All of the work described in this report was accomplished in accordance with the Moses Lake Wellfield Superfund Site Quality Assurance Project Plan. In addition, the teams followed the guidance presented in: the Seattle District, USACE Safety and Health Plan; USACE Safety Manual EM 385-1-1; Seattle District, USACE, Sampling Standard Operating Procedures (SOP).

The private wells and monitoring wells designated for sampling are displayed on a map found at Appendix A. These wells have been selected based on their down-gradient locations relative to the inferred flow direction of TCE-contaminated groundwater and validated sampling analytical data from previous monitoring events.

The two environmental field teams deployed to the Site and collected groundwater samples from 15 private well systems, and 28 monitoring wells during the February 2016 sampling event as summarized below:

Team 1: Joseph Marsh and Matthew Brookshier collected groundwater samples from 4 monitoring wells fitted with dedicated bladder pumps, and 10 monitoring wells fitted with laboratory-filled passive diffusion bag samplers. Team 1 also collected static water level data from all other designated project monitoring wells in coordination with team 2. These activities were conducted between 22 and 25 February 2016.

Team 2: Karah Haskins and Jacob Williams collected groundwater samples from 10 private whole-house filter systems, 5 private well systems and 14 monitoring wells fitted with passive diffusion bags. In coordination with team 1, they also collected static water level data in designated project monitoring wells as required. These activities were conducted between 22 and 25 February 2016.

The objectives of groundwater sampling at Moses Lake are to: 1) collect representative samples from designated private well systems and monitoring wells yielding data of known and sufficient quality to evaluate TCE concentrations and define existing TCE plumes; 2) to assure compliance with the requirements of USEPA; and 3) to make critical project - specific decisions based on the evaluated data.

2.0 DESCRIPTION OF WORK

2.1 ACTIVITIES PRIOR TO THE FEBRUARY 2016 GROUNDWATER SAMPLING EVENT

The USACE project team worked to collect signatures on Department of the Army Right of Entry forms as required before conducting the well sampling on private, city or county government property. For most properties, previously signed Right of Entry forms were still valid. For all properties designated for sample collection, owners (and renters if applicable) were contacted to coordinate sample collection times during the scheduled field sampling week.

Prior to conducting sampling activities at each location, both teams verified the address or well location and map location matched, and that the Right of Entry form had been signed prior to arriving at each sampling location.

Each team was responsible for identifying potential health and safety hazards at each sampling location. If a hazard is verified at a private well sampling location, an alternate hose bib connected to the same water source may be selected in a safer area of the subject property. In the case of hazardous monitoring well conditions, the well may be situated in an active construction zone requiring the cancellation of sampling at that well until the next scheduled sampling event.

Also for private well sampling, the field team was tasked with determining the most appropriate cold-water tap or other sample port as close to each wellhead as practical. At each location, the team worked to collect water samples from the same sample point selected during previous sampling events to ensure consistent results. The team was briefed that groundwater samples would not be collected from taps delivering chlorinated, aerated, softened or filtered water.

2.2 PRIVATE WELL SAMPLING PROCEDURES

During the February 2016 groundwater sampling event, samples were collected from a total of 15 private wells consisting of: 5 private well system hose bibs (WP-4, WP-27, WP-131, WP-167, and WP-168), and 10 WHF systems (WP-14, WP-70, WP-83, WP-86, WP-119, WP-121, WP-123, WP-124, WP-125, and WP-129).

USACE (in cooperation with USEPA) has determined private well and WHF groundwater purging shall to consist of: allowing water flow at the sampling port at a rate of approximately 0.5 to 1 gallon per minute (gpm), while measuring the temperature of the water stream with a digital thermometer every two minutes until stabilization is achieved. These procedures follow the general principles of the New Hampshire private well system water sampling guidance.

During purging, the flow rate at each location was verified by graduated cylinder. While purging continued, the field team monitored the surrounding area and flowing water for unusual observations and odors as purge water was captured in a five gallon bucket. They recorded the start time of the purging in the field logbook immediately after opening each hose bib sample point and establishing the flow rate. While one team member used the digital thermometer to measure water temperatures, the other recorded the temperatures every two minutes until the parameters stabilized.

Upon reaching stabilization, the approximate total purged volume was recorded in the project field book along with any other significant observations. The team then conducted the sample collection activities.

Prior to collecting a water sample, the team reduced the flow rate at each tap to approximately 150 to 200 ml/min. to minimize sample water turbulence and aeration. The samplers donned protective eyewear and new, clean, Nitrile gloves to prevent exposure to contaminants and cross-contamination. All groundwater samples were collected in pre-cleaned certified containers obtained from the analytical laboratory.

All sample containers were filled with water directly from each tap – forming a meniscus at the top of each vial to provide zero headspace samples as required. Sample point location and components of each plumbing system were noted to assist in data interpretation. A photographic record of each sample point was made by the team. In addition, each team placed handle tags (indicating that water samples were taken by USACE on that date and time) on the front doors of homes sampled if nobody was home during sample collection. A photo was taken of the handle tag and front of house in that case for the project files.

After the sample containers have been filled, sample labels describing project, location, analysis, team members, preservative, sampling date, and collection time are placed on the containers. The samples are then packaged in bubble wrap bags and plastic zipper type bags, placed into pre-iced sample shipping coolers and prepared for shipment as described in Section 3.0. All sampling teams worked to ensure each property was left just as they found it with no damage done, and any doors or gates closed as required.

2.3 Whole House Filter Sampling Procedures

In coordination with USEPA and affected Moses Lake area homeowners, granular activated carbon (GAC) water filters have been installed in private well systems showing TCE results of 3.5 µg/l or greater. Each GAC filter system consists of two lightweight composite GAC filter tanks (acting as lead and lag filters), associated piping, bag filters (to prevent GAC particles from entering the household plumbing system), pressure gauges and valved/regulated sample collection ports.

As described previously, groundwater samples were collected from 10 WHF systems during this February 2016 sampling event. Each system was purged according to the revised private well sampling SOP consisting of allowing water flow at a hose bib nearest the wellhead at a rate of approximately 0.5 to 1 gpm, while measuring the temperature of the water stream with a digital thermometer every two minutes until stabilization is achieved. Purge flow rates averaged approximately 0.5 gpm as measured with graduated cylinder, and purged water at each location was captured in a five gallon bucket to verify purged volumes. During purging, continuous temperature readings were recorded using a digital thermometer until water temperature stabilization was achieved. Once water temperature had stabilized, the hose bib was closed, and the field team prepared to collect samples from the pre-determined WHF sample ports (labeled “A” for the lead inlet port, “B” for the lead outlet port, and “C” for the lag outlet port).

WHF sample collection consists of opening each designated sample port valve fully to allow the maximum restricted flow rate of approximately 150 to 200 ml/min to flow into a capture bucket for a few seconds to ensure organic matter or air bubbles have been flushed out of the system. Restrictors have been placed on the sampling lines to provide a smooth, non-turbulent stream at a low-flow rate to minimize loss of volatiles that may be present in the water stream. Next, the sampling team immediately fills three pre-preserved VOA vials to zero headspace. New Nitrile gloves were donned before collecting samples at each port. All discharged water was directed into a five gallon plastic bucket for transfer to ground surface away from the shed or pump house GAC filter location after the samples were collected.

After filling the sample containers, sample labels describing project, location, analysis, team members, preservative, sampling date, and collection time were placed on each container and the container was placed in a plastic zipper bag. The bagged sample vials were placed into bubble wrap bags. Finally, the filled sample containers were placed into pre-iced shipping coolers to begin sample cooling to the required 4° Celsius sample preservation temperature prior to shipment to the analytical laboratory. One set of trip blanks were required and included per sample shipping cooler.

2.4 Monitoring Well Sampling Procedures

2.4.1 Monitoring Well Sampling Using Dedicated Bladder Pumps

Moses Lake monitoring well groundwater purging and sampling was performed in accordance with the Seattle District’s Low-Flow Ground Water Purging and Sampling SOP, prepared in March 1999 and revised on 1 Sep 2009. Data generated during purging were recorded on the MicroPurge/Low-Flow Sampling Log forms (Appendix C).

The team verified each monitoring well location and identification number with project maps and tables. They verified work can proceed safely in the vicinity of moving vehicular traffic, heavy industry, and other hazards as required. The team used a pry bar, socket wrench or pinhead hex wrench as needed to open each flush mount monitoring well cover plate, and a Masterlock #485 padlock key for the standard “stick-up” well completions. Prior to purging each well, the depth to static water level in each well was measured and checked periodically to monitor draw down as a guide to flow rate adjustment (no greater than 0.4 foot drawdown is permitted to prevent sampling stagnant casing water).

Purging operations at each well commenced once the following equipment was prepared: the MP20 MicroPurge® Controller equipped with an adjustable pressure regulator was connected to the Well Wizard® bladder pumps via air line and quick connect fittings. Another air line was quick-connected to a pressurized CO_2 cylinder to drive the pump. Pump flow rates were then adjusted during a “pre-purge” period to maximize withdrawal rates and minimize excessive drawdown in each well. The evacuated pre-purge volume at each well was intended to flush out a bladder pump and tubing volume prior to monitoring stabilization parameters. Finally, a QED MicroPurge® basics MP20 Flow Cell was connected to the pump’s discharge line at ground surface to measure established water quality stabilization parameters (pH, specific conductivity, temperature, DO, ORP, and turbidity).

Depth to water measurements during purging were monitored and recorded to verify that minimal drawdown occurred. A graduated measuring cup was used to determine the volume purged. Generally, acceptable low-flow rates are no greater than 500 milliliters per minute (ml/min.), and are typically closer to 400 ml/min. for the Well Wizard® bladder pump systems, depending upon the amount of water level drawdown detected during pumping at each well. Purge data was recorded on the micro-purge logs every two minutes.

Low-flow purging continued until three consecutive measurements of the stabilization parameters met stabilization requirements.

Stabilization parameter requirements for all private well and bladder pump monitoring wells are as follows:

Temperature	+/- 0.2 ºC
Specific Conductivity	+/- 0.020 millisiemens/centimeter (mS/cm)
DO	+/- 0.2 milligrams/liter (mg/l)
pH	+/- 0.2 units
ORP	+/- 20 millivolts (mV)

At each monitoring well, groundwater sample collection would begin immediately after achieving stabilization of water quality parameters during low flow purging.

Prior to sample collection, the samplers donned protective eyewear and new, clean, Nitrile gloves to prevent exposure to contaminants and cross-contamination. All groundwater samples were collected in pre-cleaned, certified containers obtained from the analytical laboratory.

All sample containers were filled immediately following purging by disconnecting the flow-through cell from the pump tubing system, and capturing water directly from the discharge end of the tubing. All sample containers were carefully filled at a low-flow rate to minimize agitation. During sample collection, significant physical observations were recorded in the Micropurge/Low-Flow Sampling Log data forms and project field book as needed.

After filling the sample containers, sample labels describing project, location, analysis, team members, preservative, sampling date, and collection time were placed on each container and the container was placed in a plastic zipper bag. The bagged sample vials were placed into bubble wrap bags. Finally, the filled sample containers were placed into pre-iced shipping coolers to begin sample cooling to the required 4° Celsius sample preservation temperature prior to shipment to the analytical laboratory. One set of trip blanks were required and included per sample shipping cooler.

At the conclusion of groundwater sampling at each well, the flush mount well covers were bolted closed and stick up well caps padlocked.

2.4.2 Monitoring Well Sampling Using Passive Diffusion Bags

Passive diffusion bags (PDBs) were been selected by the Moses lake Project Delivery Team as the most appropriate, cost-effective method for groundwater sample collection from Moses Lake monitoring wells lacking dedicated bladder pumps. The PDBs were purchased from ALS Environmental laboratory under license by the US Geological Survey and The General Electric Company, both co patent-holders. The 1 ¼" diameter low-density polyethylene PDBs were pre-filled with 220 ml or 330 ml of ASTM Type II certified, laboratory-grade, deionized water. Each filled PDB was then heat sealed by the laboratory prior to shipment to USACE via overnight delivery in hermetically sealed pouches.

USACE ensures a minimum of 14 days of PDB equilibration time before returning to the Moses Lake site for groundwater sample collection per established PDB guidance. During this event, both sampling teams worked to collect the PDB samples as described in Section 2.5.3. PDB retrieval and sampling consisted of the following procedures:

1. The team verified each monitoring well location and identification number with project maps and the sample matrix. They verified work can proceed safely in the vicinity of moving vehicular traffic as required. The PDBs were prepared over clean sheets of aluminum foil prior to being placed into each well. The team used a pry bar, socket wrench or pinhead hex wrench as needed to open each flush mount monitoring well cover plate, and a Masterlock #485 padlock key for the standard “stick-up” monitoring well completions. The team donned new Nitrile gloves for groundwater sample collection.

2. The team carefully hauled each weighted PDB to the surface using the nylon suspension line. The sampling team carefully cut the top corner off each PDB and filled each sample vial. The team filled each vial just to overflowing and maintained a reverse meniscus. There was no down time once the PDB has been brought to the surface until sample collection was complete at each well. Any residual sample water in the used PDBs was discharged to ground surface.

3. Each PDB represented a unique sample ID number based on the well ID (and sample interval if two PDBs are deployed into one well). With the exception of the MS/MSD, all QC samples were submitted “blind” to the laboratory using a separate unique sample ID number not labeled as duplicate or trip blank per USACE standard sampling procedure. One set of trip blanks were required and included per sample shipping cooler. An extra laboratory- prepared

PDB was shipped to the site and was used for collection of the trip and field blanks at the direction of the USACE project chemist.

4. Once recovered and sampled the PDBs and suspension lines were be discarded as non-hazardous municipal waste. In addition, gloves, paper towels, bags, and other solid waste materials were disposed of as municipal waste. The PDBs and other solid waste material were placed into a large plastic garbage bag and tied securely prior to disposal. The stainless steel weights were decontaminated and returned to the Seattle District, USACE office.

5. Finally, the team securely capped and locked each monitoring well riser and cover plate when finished.

2.5 Sampling Event Activities and Observations

2.5.1 Team 1 Monitoring Well Bladder Pump Sampling

Groundwater sample collection commenced immediately after achieving stabilization of water quality parameters during low flow purging at each well using dedicated bladder pump systems as described previously. The team worked from the far north end of the Site, moving to the far south end sampling each designated well as it was encountered. The project well maps and sample matrix were used to ensure samples were collected at the correct locations. The team used one 15 lb. compressed CO_2 cylinder acquired from Oxarc in Moses Lake to drive the pump systems, airlines, pump controllers, and flow cells to conduct the sampling of dedicated bladder pumps.

During the February 2016 sampling event, Team 1collected groundwater samples from a pre-determined set of four monitoring wells fitted with dedicated bladder pumps: 91BW04, 92BW01, 99BW10, and 99BW18.

Even though a right of entry permit has been signed, and verbal or written permission granted to collect samples at each designated monitoring well, the sampling team always attempted to contact the property owner for each monitoring well location before beginning the field sampling activities.

Per agreement with Grant County Airport security, Joseph Marsh used his ramp security badge to access all monitoring wells within the restricted area without an escort. On the afternoon of 23 February, 2016, water levels were measured in the following airport wells: 00BW12, 00BW03, 00BW02, 00BW11, 91BW02, 00BW08, and 00BW06. Both teams worked together to measure static water levels in all other designated project monitoring wells before completing the sampling event.

Other than property owner notifications, no special access procedures were required for any of the other bladder pump monitoring wells sampled during this event.

Prior to sample collection, the samplers donned protective eyewear and new, clean, Nitrile gloves to prevent exposure to contaminants and cross-contamination. All sample containers were filled immediately following low-flow purging by disconnecting the flow-through cell from the pump tubing system, and capturing pumped groundwater directly from the discharge end of the pump tubing. During sample collection, physical observations were recorded in the Micro-purge/Low-Flow Sampling Log data forms.

Stabilization of water quality parameters during purging occurred within six minutes during this event. Measured temperatures ranged from 12.61°C at well 91BW04 to 13.85°C at well 99BW10. Specific conductivity ranged from 0.35mS/cm (well 99BW10) to 0.49 mS/cm (well 91BW04). Dissolved oxygen measurements ranged from 5.31 ppm (well 99BW18) to 6.81 ppm (well 92BW01). PH values ranged from 6.59 units (well 92BW01) to 7.39 units (well 91BW04). Oxygen reduction potential ranged from 94 mV (well 99BW10) to 251 mV (well 92BW01).

Significant Observations Made During Team 1 Bladder Pump Sampling

Team 1 met with the new manager of Airport Mini-Storage (8524 Broad Street, NE, Moses Lake) while conducting sampling activities at well 99BW10. She reported that a new security fence would be installed soon, and we would need a proximity card or passcode to open the gate. The team exchanged information with her, and she promised to give us a proximity card or the passcode before the next sampling event. Wells 99BW10, 02BW01, and 04CW07 are located on mini-storage property.

Team 1 met with a neighbor while measuring water levels at well 04CW08. He reported the property where this well is located has been sold. He thought the new owners are planning to install a private well on this property, and would probably like to talk to us. A new right of entry form must be signed if, in fact, the property has been sold.

During water level measurements at well 91BW02, a slight petroleum odor was noted on the water meter cable as detected previously – possibly related to active petroleum remediation efforts being conducted by contractor for the Port at this location.

No other significant observations were made during this event.

2.5.2 Team 2 Private Well System Sampling

While environmental field team 1 worked independently on their set of wells, Team 2 collected samples at their own pre-assigned set of 10 whole house filter well system sample ports, five private well system hose bibs, and 14 PDB monitoring wells requiring sampling and/or PDB installation for the next sampling event.

During the period of 22-25 February 2016, Team 2 collected groundwater samples from the following 10 private well systems with whole house filters installed: WP-14, WP-70, WP-83, WP-86, WP-119, WP-121, WP-123, WP-124, WP-125, and WP-129. During that same time period, they collected groundwater samples from the following five private well systems: WP-4, WP-27, WP-131, WP-167, and WP-168.

All required 40 ml VOA sample vials were obtained from Vendor ESS by the USACE contract lab ARI, and delivered to USACE pre-preserved with maleic and ascorbic acid.

Trip blanks were sent inside each sample shipping cooler delivered to the analytical lab.

Upon arrival at each private well property designated for sample collection, the team verified they were at the correct address using maps, notes, and the sampling matrix, and verified through field documentation they were ready to collect samples at the correct sampling point (hose bib, or suitable water discharge port nearest to the wellhead. The team always attempted to contact the owner or resident at each private well location before beginning the field sampling activities.

Per modified SOP, sampling point valves were opened, and water allowed to flow at approximately 0.5 to 1 gpm into a capture bucket. Next, water temperature readings were measured every two minutes until stabilization was achieved. During the February sampling event, water temperature stabilization ranged from 4 to 8 minutes elapsed purging time with most locations reaching stabilization within six minutes as shown in Table 1 below.

TABLE 1: PRIVATE WELL STABILIZED WATER TEMPERATURES AND PURGE TIMES

Well Location ID	Stable Temp. °C	Total Purge Time (Minutes)
WP-04	15.7	**8**
WP-14	18.2	6
WP-27	15.1	6
WP-70	14.9	6
WP-83	11.8	6
WP-86	8.0	6
WP-119	7.4	6
WP-121	7.8	6
WP-123	8.3	6
WP-124	na	na
WP-125	14.2	4
WP-129	20.8	6

WP-131	11.7	6
WP-167	13.8	6
WP-168	No stabilization	na

Note: Team could not access hose bib for water temperatures at WP-124. Temperature did not stabilize at WP-168, so team purged one gpm for 15 minutes and then collected samples.

Upon achieving stabilization, the final stabilized readings were entered into the project field book. Prior to collecting a water sample, the flow rate at each tap was reduced to approximately 100 to 200 ml/min. to minimize sample aeration and turbulence. The sampling team donned new Nitrile gloves prior to sample collection at each residence. In the case of the WHF sample ports, restrictors on the sample ports provided a stream of sample water at approximately 150 to 200 ml/min. All sample containers were be filled with water directly from each tap – forming a meniscus at the top of each vial to provide zero headspace samples as required. A photographic record of each sample point was made by the team.

Significant observations made during Private Well/WHF Sampling

Team 2 will arrange with the property owners at WP-04 to pick up a spare key to the well house to make access easier in the future. Team 2 was also told by business on site that they do not drink the well water (they have bottled water delivered), and the well water was being used by the concrete mix plant, also on the property.

Rainwater was observed filling flush mount well vaults to top of the well casings at 12EX02, 12BW08, and 12BW06. Sufficient rainwater was bailed out of the well vaults to prevent the water from draining into the well casings once the water-tight plugs were removed for sampling.

At WP-167, the closest hose bib to the wellhead is of the type that does not permit low flow sampling. Care was taken to collect representative samples at this location.

At WP-27, the purged water appeared milky white at first (possibly due to numerous micro-sized bubbles), then ran clear by end of purge time.

At WP-124, the team could not safely access the hose bib for purging. Samples were collected from designated ports after purging the sample tubing. The team also detected pesticide/herbicide/fertilizer odors in the well house.

No other significant observations were made during this event.

2.5.3 Passive Diffusion Bag Sampling and Deployment

Both USACE environmental field teams split up the effort of PDB sample collection and deployment of new pre-filled PDBs in a pre-determined set of 24 monitoring wells during the February 2016 event.

The selected PDB wells were: 02-BW01; 04-BW09; 04-CW05; 04-CW07; 12-BW02; 12-BW03; 12-BW04; 12-BW05; 12-BW06; 12-BW07; 12-BW08; 12-CW01; 12-CW02; 12-CW03; 12-CW04; 12-CW05; 12-EX01; 12-EX02; 14BW01, 14BW02, 14BW03, 14EX03, 14EX04, and 14EX05.

All required 40 ml amber glass VOA sample vials were obtained from Vendor ESS (certified new, clean, QC Class) by the USACE contract lab ARI, and delivered to USACE pre-preserved with maleic and ascorbic acid.

The teams first verified each monitoring well location and identification number with project maps and the sample matrix. The teams also verified that work could proceed safely in the vicinity of moving vehicular traffic or other physical, biological, or environmental hazards that may have been present near each monitoring well.

Each team member donned new Nitrile gloves for groundwater sample collection at each well. Once the wells were unlocked and opened, one team member lifted the well riser plug and began hauling the PDB vertically to the surface.

Once each PDB was raised to the surface, the sampling team worked together to carefully cut the top corner off each bag using decontaminated steel scissors. Next, one person held the open sample vials and the other carefully and slowly tilted the bags - open side down - toward each open sample vial. The pre-preserved vials were filled just to overflowing to maintain a reverse meniscus. Then the vials were immediately capped making sure there were no bubbles or headspace per standard VOC sampling procedure. This entire sampling process can be completed within one minute to minimize loss of volatiles while preventing introduction of contaminants into the water from surface sources. After all required vials were filled; any residual sample water remaining in the used PDBs was discharged to ground surface. Therefore, no Investigation-derived waste (IDW) water was generated during this sampling event.

The sampling teams continued use of protective mesh PDB sleeves in wells with steel risers due to a greater potential for damage to the PDB membranes (monitoring wells 12EX01, 12EX02, 14EX03, 14EX04, and 14EX05).

Once recovered and sample water removed, the PDBs and suspension lines were discarded as non-hazardous municipal waste. In addition, gloves, paper towels, bags, and other solid waste materials were disposed of as municipal waste. The PDBs and other solid waste material were placed into a large plastic garbage bag and tied securely prior to disposal. The stainless steel weights were decontaminated and reused during the deployment of the new pre-filled PDBs for the next sampling event.

After collecting water samples from the PDBs, the teams deployed new PDB assemblies into the following larger set of 37 monitoring wells selected for groundwater sampling during the May 2016 sampling event: 91AW07, 91AW14, 02BW01, 04BW01, 04BW04, 04BW05, 04BW06, 04BW07, 04BW09, 04CW01, 04CW02, 04CW03, 04CW04, 04CW05, 04CW07, 04CW08, 12BW01, 12BW02, 12BW03, 12BW04, 12BW05, 12BW06, 12BW07, 12BW08, 12CW01, 12CW02, 12CW03, 12CW04, 12CW05, 12EX01, 12EX02, 14BW01, 14BW02, 14BW03, 14EX03, 14EX04, and 14EX05.

For the May 2016 event, two sizes of PDBs were ordered: The bags consisted of the standard 220 ml size, and a larger 330 ml bag selected to accommodate primary and field duplicate samples where required. In some wells, two 330 ml PDBs were connected in tandem and lowered to the mid-screen depth to accommodate primary, field duplicate, and MS/MSD sample volumes as required. Two PDBs were installed at two mid-screen depths if a designated well had two screened intervals (as found in wells 04CW07, 12BW03, and 12BW04). All PDBs and stainless steel anchor weights were purchased from ALS Environmental, and shipped to the District office by UPS overnight delivery.

Following the established PDB deployment procedures, both environmental team members worked together using a table of Moses Lake monitoring well logs to determine the number of required weights, length of nylon suspension line, and number of PDBs required at each designated well.

Each team member donned a new pair of Nitrile gloves prior to working on PDB assemblies at each well. Steel weights, suspension lines, and PDBs were quickly assembled on a strip of clean aluminum foil on the tailgate of the sampling vehicle. The prepared assembly of PDB, suspension lines, and weights was lowered into place at each well within 10 to 15 minutes to reduce the possibility of contaminants entering the diffusion bags during deployment.

At each specific well, the team lowered the weight into the well first, followed by the suspension line and PDB. The team worked to keep the assembly centered within the well casing as they slowly lower it to the well bottom. When the team felt the weight hit well bottom, they pulled up the line approximately one foot and tied it off securely to the casing plug or well cap. This method ensured the PDB would always be centered at the mid-well screen depth. Finally, the well cap was locked, or the cover plate secured with locking bolts depending on type of well encountered – stick up or flush mount.

All laboratory-filled PDBs arrived at the USACE office in good condition prior to field deployment. Each PDB was packed in groups of 10 into sealed foil pouches to prevent inadvertent contamination until deployment into the designated monitoring wells. No specific difficulties or problems were noted during PDB deployment.

Significant Observations Made During Passive Diffusion Bag Sampling

Numerous rust particles were observed on the PDBs and PDB suspension lines installed in wells 14EX03 and 14EX04.

No other significant observations were made during this event.

3.0 Investigation-Derived Waste

No investigation-derived waste was generated during this sampling event. All residual PDB water or purged well water was transferred directly to ground surface on each property away from the sample collection point.

4.0 SAMPLE PACKAGING AND DELIVERY

As mentioned in the narrative of each sampling event, groundwater samples were packaged in shipping coolers on ice and under chain of custody for overnight shipment to the USACE contract laboratory Analytical Resources, Inc. during the course of the sampling event.

All sample shipping coolers were prepared for laboratory delivery in the following manner: Each cooler was lined (sides and bottom) with plastic “bubble-wrap” sheets for shock absorption. A large 30-gallon plastic garbage bag was then placed into the cooler to contain the sample water in the event of container breakage during shipment to the laboratories. The glass sample vials were labeled, placed into plastic zip-seal bags, and placed into foam shipping blocks or bubble-wrap bags for shock protection. All the samples were placed in the shipping coolers as indicated on the corresponding chain of custody forms. Gallon size plastic zipper bags of cubed ice bags were placed between and on top of the samples in each cooler to ensure maintenance of the required four degrees Celsius (plus/minus two degrees) sample preservation temperature. The completed chain of custody (COC) forms were placed in gallon size plastic zipper bags and taped to the inside of each cooler lid. Two custody seals were affixed to the outside of each cooler. The custody seals were placed so that the coolers could not be opened without breaking the seals. Each cooler was then securely sealed with fiber tape. The field team ensured drain plugs were securely taped inside and out to prevent possible water leakage.

The laboratory was informed of the sample delivery and ensured the samples were properly accepted and checked in upon receipt the following morning after the sample containers were shipped. All sample coolers and sample containers were accounted for at the contract laboratory following each shipment.

5.0 LABORATORY ANALYSIS

Chemical analyses performed on the samples were as follows: VOCs (Method 524.3). Also, for a pre-determined subset of four private whole house filter system wells (WP-119, WP-121, WP-124, and WP-125), groundwater samples were intended to be collected for Perfluorinated Compounds. However, the analytical laboratory did not supply sufficient sample containers to collect the required sample volume according to the analytical method. These samples will be collected during the May 2016 sampling event.

6.0 DECONTAMINATION PROCEDURES

PDB weights, flow cells and associated tubing, water level indicator meters, and water volume measurement containers used by each team were decontaminated at the end of the project with an Alconox®-water solution followed by triple rinsing using distilled water in the USACE Geology Laboratory.

7.0 PROTECTION LEVEL

All sampling activities were conducted under Worker Protection Level D. For this project, personnel protective equipment included reflective safety vests, safety splash protection glasses, Nitrile gloves, and safety steel toe boots. New pairs of Nitrile gloves were donned prior to handling acid-preserved sample containers and between each unique private well sample point or monitoring well.

End of Field Sampling Report

APPENDIX A

Site and Well Location Maps

(Available in USACE Project Files)

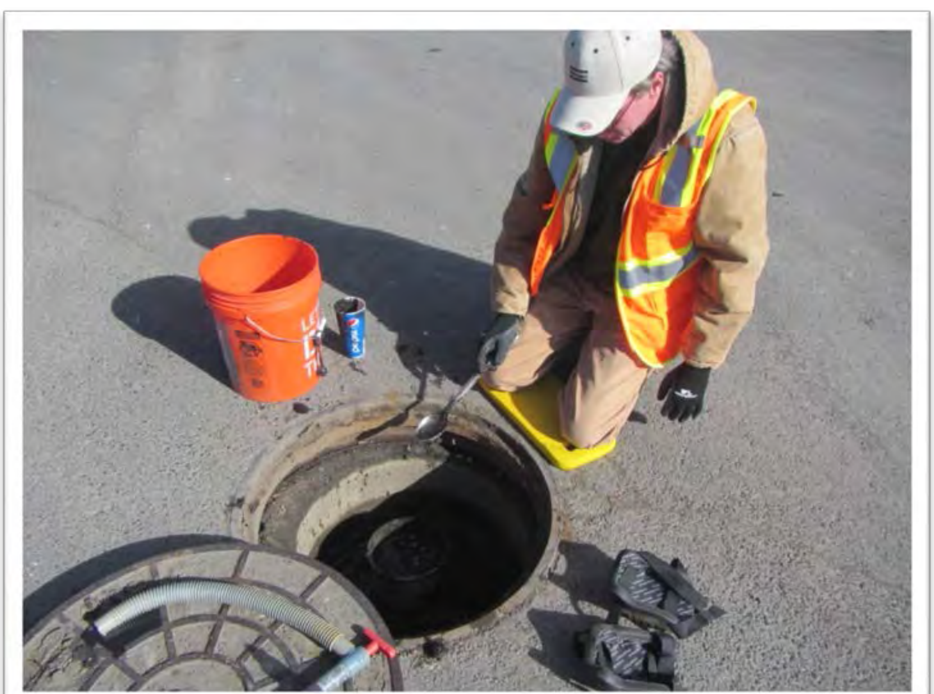
APPENDIX B

Field Sampling Photos

Figure 1

(160222-04CW01-1)Matt Brookshier shown ready to deploy new passive diffusion bag into well 04CW01.

Figure 2



(160223-00BW14-1) Matt Brookshier shown cleaning out well vault to access well 00BW14.

Photographer: Joseph Marsh

US Army Corps of Engineers ®
Seattle District

Figure 3

(160222-99BW09-1) Close proximity of New Genie lift vehicles to well 99BW09.

Figure 4

(160223-99BW10-1) Purging bladder pump well 99BW10.

Photographer: Joseph Marsh

US Army Corps of Engineers ®
Seattle District

Figure 5

(160223-92BW01-2) Many monitoring well padlocks are beginning to show signs of corrosion, and will need to be replaced in the near future.

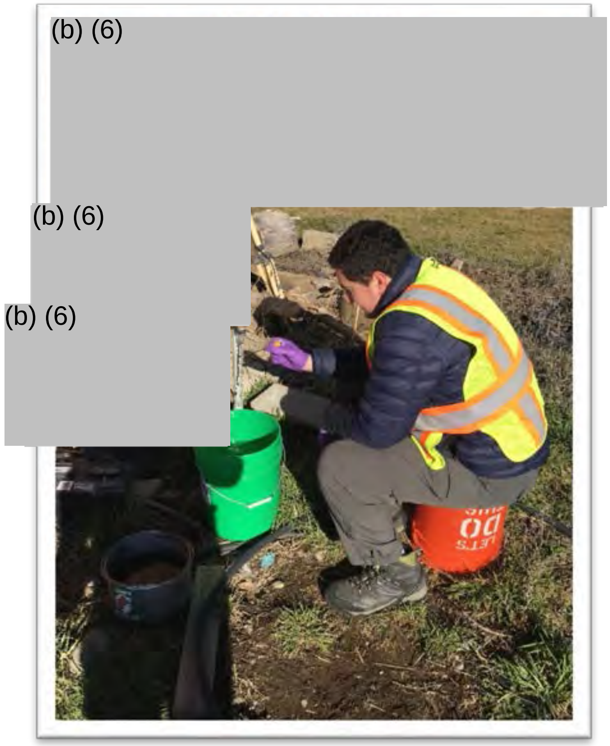
Figure 6

(160222-WP04) Purging activities at well WP04.

US Army Corps of Engineers®
Seattle District

Photographer: Marsh/Haskins

Figure 9



(160223-WP14) Jake Williams shown measuring water temperature for stabilization from yard hydrant nearest to well WP-14.

Figure 10

(160224-WP27) Measuring water temperature at well WP-27.

Photographer: Karah Haskins

US Army Corps of Engineers
Seattle District

Figure 7

(b) (6)

(160224-WP123) Door handle tag left after sampling at WP123 where residents were not at home.

Figure 8

(160224-WP125) Teflon sample tubing used for purging and sampling at well WP125.

Photographer: Karah Haskins

APPENDIX C

Field Notes
(Micropurge Logs available in USACE Project Files)

PROJECT: MOSES LAKE WELLFIELD

Groundwater Sampling

FY-16

TEAM 1

Rite in the Rain®

ALL-WEATHER

LEVEL

№ 311

Project: Moses Lake Wellfield
February 2016 Groundwater Sampling
Team: Joseph Marsh
Matt Brookshier (Team 1)

SAMPLING TABLE

WELL	SAMPLE ID	(2016) DATE	TIME	VOC (524.3) 3 x 40ml VOA pres. Mal/Asc Acid
92BW01	1602N92BW01	2-23	0850	9 *
92BW01 F.D.	1602D92BW01	2-23	0920	3
91BW04	1602N91BW04	2-23	0935	3
99BW18	1602N99BW18	2-23	1020	3
99BW10	1602N99BW10	2-23	1059	3
Trip Blank	1602TB01	2-23	1130	2

- All samples on this page shipped in Cooler A1 for delivery to ARI.
- only 2 vials required for trip blank.

* Extra Volume for MS-MSD.

Moses Lake Wellfield
February 2016 Groundwater Sampling
Table continued..

WELL	SAMPLE ID	(2016) DATE	TIME	VOC's (524.3)	
04BW09	1602N04BW09	2-24	1226	3	
04CW05	1602N04CW05	2-24	0935	~~9*~~ 3	
04CW05 F.D.	~~1602D04CW05~~	~~2-24~~	NA	~~3~~ NA	
12BW04	1602N12BW04A	2-24	1352	3	Dual comp.
12BW04	1602N12BW04B	2-24	1358	3	Dual Comp.
12BW05	1602N12BW05	2-24	0859	3	
12BW07	1602N12BW07	2-24	0959	3	
12CW03	1602N12CW03	2-24	1339	3	
12CW04	1602N12CW04	2-24	0840	3	
12EX01	1602N12EX01	2-24	1015	3	
14BW03	1602N14BW03	2-24	1304	~~3~~ 9*	
14EX05	1602N14EX05	2-24	1245	3	
PDB Pre-Deploy Trip	1602PDTB01	2-24	1407	3	
Trip Blank	1602TB02	2-24	1430	2	
14BW03 F.D.	1602D14BW03	2-24	1320	3	

- All samples on this page shipped in cooler A2 for delivery to ARI.
- only 2 vials required for trip Blank.

* Extra Volume for MS/MSD.

Moses Lake Wellfield

2-22-16 Groundwater Sampling Team 1

Joseph Marsh, Matt Brookshier

Project start → SWL readings from monitoring wells

1235 99BW16 = 123.77' - start of field event

91AW14 = 123.13'

		Deployed:
04CW01 = 159.4'	→	2 ea 330 mL PDB
1259 = 04BW04 = 137.79'	→	1 ea. 220 mL PDB
04CW02 = 160.79'	→	1 ea. 220 ml
04BW05 = 129.80	→	1 ea. 220 ml

* Note: safety plan briefed at start of fieldwork

	SWL	Deployed:
04BW01 =	64.04'	1 ea. 220 mL PDB
01BW01 =	64.84'	—
00BW05 =	64.07'	—
00BW01 =	46.70'	—

CD51 - Vault flooded - will return tomorrow, SWL

00BW09 =	70.08'	—
00BW04 =	62.82'	—
00BW07 =	68.27'	—
02BW02 =	69.64'	—
99BW15 =	70.31'	—
99BW14 =	59.56'	—
99BW12 =	112.57'	—

1615 - end of Day 1

[signature]

2-23-16 Moses Lake Wellfield Feb. 2016 Groundwater Sampling Field Notes, Cont.

0730 - Travel to Safeway to buy ice for sampler today. Mob. to field after Bagging ice for sample preservation

0814 - Setup @ 92BW01 bagging ice, flow cell calibrated, SWL = 84.70' purging stagnant water from system - then micropurge to stability

0850 - Sample time (P)

(0920) - Sample time (PD), Close + lock well. mob. to next well 91BW09

setup - SWL = 85.04' prepurging stagnant water from system Micropurge to stability

0935 - Sample time Close + lock well, Mob. to 99BW18

0956 setup + prepurging stagnant system water. Micropurge to stabilization

1022 = Sample time, NSTR. Close + lock well, Mob. to 99BW10 Setup + prepurging of stagnant water in casing - then micropurge to stabilization. SWL = 131.43'

1059 = Sample time, close + lock well

2-23-16 cont.

- Met new manager at Mini-Storage
  - She says the property will have an electronic fence requiring a key card or code in near future — She will coordinate with us when the upgrade is implemented — (I gave her my business card - J. Marsh)

1220 - Delivered one cooler (A1) with groundwater samples to ARI via Grant County Airport Fedex.

1230 - 1300 Lunch

~~1250~~ 1310 pm 00BW14 SWL = 56.21' @ CDS1 well after cleaning out vault filled with sediment + surface water.

- Mob. to airport wells for water levels.

SWLs

00BW12	=	79.21'	
00BW03	=	82.78'	
00BW02	=	86.35'	
00BW11	=	91.91'	No fuel odor
00BW08	=	91.01'	
91BW02	=	92.43'	minor fuel-Petro odor
00BW06	=	146.99'	
(Tank Farm) → 04BW06	=	105.11'	→ 1 ~~200ml~~ PDB deployed

2-23-16 cont.

Mob. to "Tank farm" wells

		SWL	
04CW03	=	136.47'	→ installed 220ml PDB; Needs new locks
99BW01	=	89.24	Needs new locks
91AW07	=	87.65'	→ installed 220ml PDB
91BW03	=	89.07'	
92BW02	=	82.08'	
1537 hrs. 00BW15	=	79.92'	
99BW09	=	72.77'	
1557 hrs. 00BW10	=	137.00'	church lot
04CW08	=	142.55'	old PDB removed new 220ml PDB Deployed

→ Talked to neighbor —

(b) (6) (b) (6)

We will need get a new

ROE signed.

1630 - end of field day.

Rite in the Rain

Moses Lake wellfield

2-24-16

0730 - returned used CO_2 bottle to OXARC
- picked up 2 bags 10lb. ice at Safeway.

0800 Mobilize to wellfield, setup at first PDB well - 12CW04 SWL= 100.73'
PDB (220ml) pulled, sample time = 0840
close + lock well. mob to adjacent well

0850 = 12BW05 91.17' = SWL one 220ml PDB
retrieved - sample time = 0859
deploy 1 new 220ml PDB in both wells 12CW04 + 12BW05 at this Location. close + lock well.

- Mob. to 04CW05 SWL = 98.55'
pulling one 220mL PDB - should be 2 330ml PDBs
0935 = Sample time (P) 0935 NA ~~Sample time (FD)~~
*Cannot take MSMSD or FD sample here,
deployed 2 220ml PDB here for P, MSMSD, FD Next time per plan.

0951 12BW07 SWL = 90.22'
pulled one PDB 220ml Sample time = 0959
replace one new 220ml PDB

12EX01 SWL = 90.27'
pulled one 220ml PDB in Mesh - rusty from casing. Sample time = 1015
deploy one New 220ml PDB in Mesh into well.

2-24-16 continued

1130 1200 hrs. Lunch break.

1300 - 04BW09 flush mount SWL = 86.04'
pulling PDB - one 220ml.
Sample time = 1226, replacing well with New 220ml PDB. close-lock well
Mob. to 2

14EX05 SWL = 88.00'
pulled PDB 1x220ml Sample time = 1245
deployed one 220ml PDB, close + lock well

14BW03 SWL: 88.14'
pulled PDB (2x 330ml Bags here Not per Plan)
will take P/MSMSD/ and FD here Sample time = (P) 1304
= (FD) 1320
redeploy one 220ml PDB in this well

12BW04 SWL = 99.95'
pulled 2 intervals ~~Bags~~ 2 220ml Bags.
A sample time = 1352
B Sample time = 1358
2x 220ml Bags redeployed in well
close + lock well

12CW03 SWL = 107.52'
pulled one 220ml PDB, replaced with New 220ml PDB Sample time = 1339
close + lock well

2-24-16 cont. (Cooler A2)

1445 * Shipped one sample cooler to ARI via Fedex

04BW07 = SWL = 125.74'
deployed one 220ml PDB per plan

04CW04 - SWL = 126.45'
deployed one 220ml PDB per plan

00BW13 -> SWL = 85.79'
* closed + locked each well sampled at end.

1610hrs - 12BW01 SWL = 85.87'
deployed 1 new 220 mL PDB
per Plan for May sampling close
+ lock well.

* re-installed new bolts in well
cover plate (15/16" bolts) at well
12CW01.

1625 - end of Day.

[signature]

$\boxed{\text{2-25-16}}$ Moses Lake Wellfield
~~a~~ Team / GW Sampling

water level readings

0846 - 99BW11 - SWL = 50.15'
0902 - 00BW16 - SWL = 133.51'
1000 - Meeting at new monitoring well site.
Sampling event complete
1100 - Return to District Office

[signature]

Project: Moses Lake Wellfield
Groundwater Sampling

Book 7

Rite in the Rain®
ALL-WEATHER
ENVIRONMENTAL
FIELD BOOK
№ 550F

FY 15/16 MAY 2015 Thru

TEAM 2

Location Moses Lake Date 2/22/16

Project / Client
Feb 2016 sampling

WP-04 need to call about getting copy of key for future.

purged 7 gal

time	0	2	4	6	8
temp	16.1	16.1	16.1	15.7	15.7

Water used to be pumped to tank for use in bldg but pipe was crushed. Only people that use pump are CWC.

Guy in bldg does not recall people drinking water because ~~it was~~ bldg has delivered drinking water

Sample time 1321

12EX02 rain water in casing had some flaky white floating in water. Water was level with well head

Location Moses Lake Date 2/22/16

Project / Client
Feb 2016 Sampling

WL: 119.57 ←
Sample time 1353

12BW08
Water in casing up to well head

WL: 119.42
Sampling 1420

12CW01

WL: 132.51
Sample time 1455

NEEDS SCREWS/BOLTS

12BW02

WL: 116.82
Sample time 1515

END DAY 1

RH

Location Moses Lake Date 2/23

Project / Client

Feb 2016 sampling

12CW02

WL: 150.03
sample time: 0810

12BW03

WL: 128.34

Sample time
A 0830
B0835

WP-83

Temp	11.8	11.8	11.8	11.8
Time	0	2	4	6

Totalizer: 1831337.0
purged 5 gal
sample A: 0922

Location Moses Lake Date 2/23

Project / Client

Feb 2016 sampling

WP-14 totalizer 1,570,457.1

time	0	2	4	6
temp	18.4	18.4	18.2	18.2

purged 7 gal
sample time 0940

14BW02

WL: 107.81
sampletime: 1000

14EX04
WL: 108.03
sample time: 1023

12BW06
water in casing to riser
WL: 117.60
Sample
N: 1110
D: 1115

Location Moses lake Date 2123

Project / Client

Feb 2016 sampling

12CW05

WL: 137.85
sample: 1140
water in well casing

WP-86

Totalizer 0537672.5

Time	0	2	4	6
Temp	8.2	8.2	8.0	8.0

purged 5gal.

sample 1425

~~WP-167~~

~~Time~~	~~0~~	~~2~~	~~4~~	~~6~~
~~Temp~~				

Location Moses lake Date 2/23/15

Project / Client Feb 2016 sampling

WP-1687

Time	0	2	4	6
Temp	13.6	13.6	13.8	13.8

purged 15gal spiget doesnt allow for low flow.

sample 1445

WP-168

Time	0	2	4	6
Temp				

(b) (6)

Temp never stabilized, purged at 1 gal/min for 15 min

sample 1510

Location Moses lake Date 2/23

Project / Client

Feb 2016

14BW01

WL: 96.05
Sample: 1615

14EX03 deployed 2-330

WL: 96.38
sample 1635

DAY 2 END KH

Location Moses lake Date 2/24/2016

Project / Client Feb 2016 sampling

WP-27

Milky colored water came out of spigot at first & then cleared

Time	0	2	4	6
Temp	15.1	15.1	15.1	15.1

water system was on when we arrived. purged 25gal

WP-129

Totalizer 999870

Time	0	2	4	6
Temp	20.7	20.8	20.8	20.8

purged 15 gal first then 5 more

Totalizer was spinning when users inside home but normal water purge spigot was not using totalizer

sample 0930

Location Moses lake Date 2/24/16
Project / Client Feb 2016 sampling

WP-119A1

Totalizer: 178,088.1

Time	0	2	4	6
Temp	7.2	7.2	7.3	7.4

VOCA: 1000
PFCA: 1020
PFCC: 1010

WP121
Totalizer: 63283.3

Time	0	2	4	6	8
Temp	7.6	7.7	7.6	7.8	

VOCA: 1020 VOC Dup: 1022
PFCA: 1025
PFCC: 1030

purged 7gal

Location Moses lake Date 2/24/16
Project / Client Feb 2016 Sampling

WP-123 no one home

Time	0	2	4	6
Temp	8.2	8.2	8.2	8.3

Totalizer: 187871.3
Sample 1100

WP-125

Time	0	2	4	6
Temp	14.2	14.2	14.2	

totalizer 332053.1

VOC/PFC A 1130
B 1135
VOC/PFC C 1140

WP-70

Time	0	2	4	6
Temp	14.9	14.9	14.9	14.9

purged 5gal
Totalizer: 223048.6
Sample: 1315

Location Moses lake Date 2/24

Project / Client

Feb 2016 sampling

WP-131

Time	0	2	4	6
Temp	11.4	11.5	11.4	11.7

purged 20 gal

sample time 1345

WP-124 totalizer 256686.7

No purge Spigot behind fence & no one home

A 1410
C 1420

1602FRB01
took field RB smelled pest/herb/fertilizer

Location Moses lake Date 2/24

Project / Client

Feb 2016 Sampling

02BW01
WL 131.17
Sample 1500

1602PDTB02
Time: 1510

04CW07
WL
~~Sample~~: 143.55

Sample A 1530
Sample B 1535

App A - May 2016 Event

Private Wells and Monitoring Wells Groundwater Sampling Field Report

May 2016 Field Sampling Event

Moses Lake Wellfield Superfund Site
Moses Lake, Washington

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Field Investigation:
16-23 May 2016

Report Prepared:
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By: Technical Services Branch

US Army Corps of Engineers ®
Seattle District

TABLE OF CONTENTS

APPENDICES

1.0 BACKGROUND AND OBJECTIVE OF INVESTIGATION

1.1 BACKGROUND

The Moses Lake Wellfield Superfund Site is located between the Grant County Airport and the City of Moses Lake, Washington. The Site includes the former Larson Air Force Base (LAFB) property, Port of Moses Lake property and adjacent private properties affected by Site groundwater contamination. The Site is listed on the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980 National Priorities List (NPL) for Uncontrolled Hazardous Waste Sites.

The Moses Lake Wellfield Superfund Site is an area of approximately 15 square miles, which includes the former LAFB, commercial facilities, and residences. The former LAFB occupied approximately 9,607 acres three miles northwest of the City of Moses Lake. The United States Air Force was active at the site from 1942 until 1966. During 1988 and 1989, the Washington State Department of Health confirmed the presence of trichloroethylene (TCE) above the Federal Maximum Contaminant Level (MCL) in three City of Moses Lake municipal wells and two Skyline community wells. The Seattle District, US Army Corps of Engineers (USACE) completed a Remedial Investigation (RI) phase in 2003. Appendix A of this report shows the general location map and a site map.

During the course of the RI, several private wells were tested and found to be contaminated with TCE. In 2001, the USACE contracted installation of carbon filtration units – known as whole house filter systems (WHF) - at five of those wells. Several years of groundwater monitoring data has been evaluated since the original WHF systems were installed.

The final results of the Phase I RI released in a report in March 1993 indicated that TCE was consistently found in shallow alluvial and upper basalt (*a*-basalt) groundwater in the central area of the former base.

On October 14, 1992, the affected areas of the former LAFB and off-site down gradient areas, termed the "Moses Lake Wellfield Contamination", were listed on the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) of 1980 for Uncontrolled Hazardous Waste Sites. The former LAFB property is one part of the Moses Lake Wellfield Superfund Site; the site also includes the contaminant plume.

Chemical results from 1993 and 1994 combined with historical data indicated that TCE occurred in the central and southern portion of the former LAFB in alluvial and *a*-basalt groundwater. In 2004, USACE confirmed TCE contamination in the next lower basalt aquifer (c-basalt). As of 1995, the data suggest that more than one source may have contributed TCE to the alluvial and *a*-basalt groundwater in the central portion of the former LAFB.

In 1998, URS Greiner completed a sampling round of private water wells and wells for Class A and Class B water systems east, south and southwest of the previously known TCE plume. There were eight detections of TCE during this study. Four wells that were previously outside the plume extent were found to be above the detection limit.

1.2 Groundwater Sampling Event Summary and Objectives

In coordination with the US Environmental Protection Agency (USEPA) Region 10, three USACE environmental field teams deployed to conduct the May 2016 Moses Lake Wellfield groundwater sampling event during a single mobilization. The events described in this report involve USACE field teams verifying sample point locations; discussion of sampling techniques; recording groundwater observations; collection of groundwater samples; and shipment of those samples by overnight delivery for laboratory analysis. Environmental sampling team members responsible for the May 2016 field event were Joseph Marsh, Matthew Brookshier, Karah Haskins, David Clark, Jacob Williams, and Blair Kinser.

All of the work described in this report was accomplished in accordance with the Moses Lake Wellfield Superfund Site Quality Assurance Project Plan (QAPP). In addition, the teams followed the guidance presented in: the Seattle District, USACE Safety and Health Plan; USACE Safety Manual EM 385-1-1; Seattle District, USACE, Sampling Standard Operating Procedures (SOP).

At the direction of USEPA, the QAPP was amended for the May 2016 sampling event to include sampling and analysis of 1,4-Dioxane and Perfluorinated Compounds (PFCs) at select wells in addition to the established sample collection and analysis for VOCs.

The private wells and monitoring wells designated for sampling are displayed on a map found at Appendix A. These wells have been selected based on their down-gradient locations relative to the inferred flow direction of TCE-contaminated groundwater and validated sampling analytical data from previous monitoring events.

The three environmental field teams deployed to the Site and collected groundwater samples from a total of 69 private well systems, and 76 monitoring wells during the May 2016 sampling event as summarized below:

Team 1: Joseph Marsh and Matthew Brookshier collected groundwater samples from 40 monitoring wells fitted with dedicated bladder pumps, and 36 monitoring wells fitted with laboratory-prepared passive diffusion bag samplers. New passive diffusion bag samplers shall be deployed during the August 2016 field event since sampling at those wells will not be required until November, 2016. Team 1 also collected static water level data from all designated project monitoring wells. These activities were conducted from 16 through 23 May 2016.

Team 2: Karah Haskins and David Clark collected groundwater samples from four private whole-house filter systems, and 28 private well systems. These activities were conducted from 16 through 18 May 2016.

Team 3: Jacob Williams and Blair Kinser collected groundwater samples from six private whole-house filter systems, and 31 private well systems. These activities were conducted from 16 through 19 May 2016.

The objectives of groundwater sampling at Moses Lake are to: 1) collect representative samples from designated private well systems and monitoring wells yielding data of known and sufficient quality to evaluate TCE concentrations and define existing TCE plumes; 2) to assure compliance with the requirements of USEPA; and 3) to make critical project - specific decisions based on the evaluated data.

2.0 DESCRIPTION OF WORK

2.1 ACTIVITIES PRIOR TO THE MAY 2016 GROUNDWATER SAMPLING EVENT

The USACE project team worked to collect signatures on Department of the Army Right of Entry forms as required before conducting the well sampling on private, city or county government property. For most properties, previously signed Right of Entry forms were still valid. For all properties designated for sample collection, owners (and renters if applicable) were contacted to coordinate sample collection times during the scheduled field sampling week.

Prior to conducting sampling activities at each location, both teams verified the address or well location and map location matched, and that the Right of Entry form had been signed prior to arriving at each sampling location.

Each team was responsible for identifying potential health and safety hazards at each sampling location. If a hazard is verified at a private well sampling location, an alternate hose bib connected to the same water source may be selected in a safer area of the subject property. In the case of hazardous monitoring well conditions, the well may be situated in an active construction zone requiring the cancellation of sampling at that well until the next scheduled sampling event.

Also for private well sampling, the field team was tasked with determining the most appropriate cold-water tap or other sample port as close to each wellhead as practical. At each location, the team worked to collect water samples from the same sample point selected during previous sampling events to ensure consistent results. The team was briefed that groundwater samples would not be collected from taps delivering chlorinated, aerated, softened or filtered water.

2.2 PRIVATE WELL SAMPLING PROCEDURES

During the May 2016 groundwater sampling event, samples were collected from a total of 69 private wells consisting of: 59 private well system hose bibs (WP-3, WP-4, WP-9, WP-10, WP-27, WP-28, WP-33, WP-45, WP-50, WP-52, WP-54, WP-57, WP-65, WP-66, WP-68, WP-69, WP-71A, WP-71B, WP-74, WP-82, WP-105, WP-111, WP-116, WP-120, WP-122, WP-126, WP-127, WP-128, WP-130, WP-131, WP-136, WP-137, WP-138, WP-139, WP-143, WP-144, WP-145, WP-147, WP-148, WP-149, WP-150, WP-152, WP-153, WP-154, WP-155, WP-156,

WP-164, WP-165, WP-167, WP-168, WP-169, WP-170, WP-171, WP-172, WP-173, WP-177, WP-178, WP-179, and WP-180), and 10 WHF systems (WP-14, WP-70, WP-83, WP-86, WP-119, WP-121, WP-123, WP-124, WP-125, and WP-129).

USACE (in cooperation with USEPA) has determined private well and WHF groundwater purging shall to consist of: allowing water flow at the sampling port at a rate of approximately 0.5 to 1 gallon per minute (gpm), while measuring the temperature of the water stream with a digital thermometer every two minutes until stabilization is achieved. These procedures follow the general principles of the New Hampshire private well system water sampling guidance.

During purging, the flow rate at each location was verified by graduated cylinder. While purging continued, the field team monitored the surrounding area and flowing water for unusual observations and odors as purge water was captured in a five gallon bucket. They recorded the start time of the purging in the field logbook immediately after opening each hose bib sample point and establishing the flow rate. While one team member used the digital thermometer to measure water temperatures, the other recorded the temperatures every two minutes until the parameters stabilized.

Upon reaching stabilization, the approximate total purged volume was recorded in the project field book along with any other significant observations. The team then conducted the sample collection activities.

Prior to collecting a water sample, the team reduced the flow rate at each tap to approximately 150 to 200 ml/min. to minimize sample water turbulence and aeration. The samplers donned protective eyewear and new, clean, Nitrile gloves to prevent exposure to contaminants and cross-contamination. All groundwater samples were collected in pre-cleaned certified containers obtained from the analytical laboratory.

All sample containers were filled with water directly from each tap – forming a meniscus at the top of each vial to provide zero headspace samples as required. Sample point location and components of each plumbing system were noted to assist in data interpretation. A photographic record of each sample point was made by the team. In addition, each team placed handle tags (indicating that water samples were taken by USACE on that date and time) on the front doors of homes sampled if nobody was home during sample collection. A photo was taken of the handle tag and front of house in that case for the project files.

After the sample containers have been filled, sample labels describing project, location, analysis, team members, preservative, sampling date, and collection time are placed on the containers. The samples are then packaged in bubble wrap bags and plastic zipper type bags, placed into pre-iced sample shipping coolers and prepared for shipment as described in Section 3.0. All sampling teams worked to ensure each property was left just as they found it with no damage done, and any doors or gates closed as required.

2.3 Whole House Filter Sampling Procedures

In coordination with USEPA and affected Moses Lake area homeowners, granular activated carbon (GAC) water filters have been installed in private well systems showing TCE results of 3.5 µg/l or greater. Each GAC filter system consists of two lightweight composite GAC filter tanks (acting as lead and lag filters), associated piping, bag filters (to prevent GAC particles from entering the household plumbing system), pressure gauges and valved/regulated sample collection ports.

As described previously, groundwater samples were collected from 10 WHF systems during this May 2016 sampling event. Each system was purged according to the revised private well sampling SOP consisting of allowing water flow at a hose bib nearest the wellhead at a rate of approximately 0.5 to 1 gpm, while measuring the temperature of the water stream with a digital thermometer every two minutes until stabilization is achieved. Purge flow rates averaged approximately 0.5 gpm as measured with graduated cylinder, and purged water at each location was captured in a five gallon bucket to verify purged volumes. During purging, continuous temperature readings were recorded using a digital thermometer until water temperature stabilization was achieved. Once water temperature had stabilized, the hose bib was closed, and the field team prepared to collect samples from the pre-determined WHF sample ports (labeled “A” for the lead inlet port, “B” for the lead outlet port, and “C” for the lag outlet port).

WHF sample collection consists of opening each designated sample port valve fully to allow the maximum restricted flow rate of approximately 150 to 200 ml/min to flow into a capture bucket for a few seconds to ensure organic matter or air bubbles have been flushed out of the system. Restrictors have been placed on the sampling lines to provide a smooth, non-turbulent stream at a low-flow rate to minimize loss of volatiles that may be present in the water stream. Next, the sampling team immediately fills three pre-preserved VOA vials to zero headspace. New Nitrile gloves were donned before collecting samples at each port. All discharged water was directed into a five gallon plastic bucket for transfer to ground surface away from the shed or pump house GAC filter location after the samples were collected.

After filling the sample containers, sample labels describing project, location, analysis, team members, preservative, sampling date, and collection time were placed on each container and the container was placed in a plastic zipper bag. The bagged sample vials were placed into bubble wrap bags. Finally, the filled sample containers were placed into pre-iced shipping coolers to begin sample cooling to the required 4° Celsius sample preservation temperature prior to shipment to the analytical laboratory. One set of trip blanks were required and included per sample shipping cooler.

2.4 Monitoring Well Sampling Procedures

2.4.1 Monitoring Well Sampling Using Dedicated Bladder Pumps

Moses Lake monitoring well groundwater purging and sampling was performed in accordance with the Seattle District's Low-Flow Ground Water Purging and Sampling SOP, prepared in March 1999 and revised on 1 Sep 2009. Data generated during purging were recorded on the MicroPurge/Low-Flow Sampling Log forms (Appendix C).

The team verified each monitoring well location and identification number with project maps and tables. They verified work can proceed safely in the vicinity of moving vehicular traffic, heavy industry, and other hazards as required. The team used a pry bar, socket wrench or pinhead hex wrench as needed to open each flush mount monitoring well cover plate, and a Masterlock #485 padlock key for the standard "stick-up" well completions. Prior to purging each well, the depth to static water level in each well was measured and checked periodically to monitor draw down as a guide to flow rate adjustment (no greater than 0.4 foot drawdown is permitted to prevent sampling stagnant casing water).

Purging operations at each well commenced once the following equipment was prepared: the MP20 MicroPurge® Controller equipped with an adjustable pressure regulator was connected to the Well Wizard® bladder pumps via airline and quick connect fittings. Another airline was quick-connected to a pressurized CO_2 cylinder to drive the pump. Pump flow rates were then adjusted during a "pre-purge" period to maximize withdrawal rates and minimize excessive drawdown in each well. The evacuated pre-purge volume at each well was intended to flush out a bladder pump and tubing volume prior to monitoring stabilization parameters. Finally, a QED MicroPurge® basics MP20 Flow Cell was connected to the pump's discharge line at ground surface to measure established water quality stabilization parameters (pH, specific conductivity, temperature, DO, ORP, and turbidity).

Depth to water measurements during purging were monitored and recorded to verify that minimal drawdown occurred. A graduated measuring cup was used to determine the volume purged. Generally, acceptable low-flow rates are no greater than 500 milliliters per minute (ml/min.), and are typically closer to 400 ml/min. for the Well Wizard® bladder pump systems, depending upon the amount of water level drawdown detected during pumping at each well. Purge data was recorded on the micro-purge logs every two minutes.

Low-flow purging continued until three consecutive measurements of the stabilization parameters met stabilization requirements.

Stabilization parameter requirements for all private well and bladder pump monitoring wells are as follows:

Temperature	+/- 0.2 ºC
Specific Conductivity	+/- 0.020 millisiemens/centimeter (mS/cm)
DO	+/- 0.2 milligrams/liter (mg/l)

pH	+/- 0.2 units
ORP	+/- 20 millivolts (mV)

At each monitoring well, groundwater sample collection would begin immediately after achieving stabilization of water quality parameters during low flow purging.

Prior to sample collection, the samplers donned protective eyewear and new, clean, Nitrile gloves to prevent exposure to contaminants and cross-contamination. All groundwater samples were collected in pre-cleaned, certified containers obtained from the analytical laboratory.

All sample containers were filled immediately following purging by disconnecting the flow-through cell from the pump tubing system, and capturing water directly from the discharge end of the tubing. All sample containers were carefully filled at a low-flow rate to minimize agitation. During sample collection, significant physical observations were recorded in the Micropurge/Low-Flow Sampling Log data forms and project field book as needed.

After filling the sample containers, sample labels describing project, location, analysis, team members, preservative, sampling date, and collection time were placed on each container and the container was placed in a plastic zipper bag. The bagged sample vials were placed into bubble wrap bags. Finally, the filled sample containers were placed into pre-iced shipping coolers to begin sample cooling to the required 4° Celsius sample preservation temperature prior to shipment to the analytical laboratory. One set of trip blanks were required and included per sample shipping cooler.

At the conclusion of groundwater sampling at each well, the flush mount well covers were bolted closed and stick up well caps padlocked.

2.4.2 Monitoring Well Sampling Using Passive Diffusion Bags

Passive diffusion bags (PDBs) were been selected by the Moses lake Project Delivery Team as the most appropriate, cost-effective method for groundwater sample collection from Moses Lake monitoring wells lacking dedicated bladder pumps. The PDBs were purchased from ALS Environmental laboratory under license by the US Geological Survey and The General Electric Company, both co patent-holders. The 1 ¼" diameter low-density polyethylene PDBs were pre-filled with 220 ml or 330 ml of ASTM Type II certified, laboratory-grade, deionized water. Each filled PDB was then heat sealed by the laboratory prior to shipment to USACE via overnight delivery in hermetically sealed pouches.

USACE ensures a minimum of 14 days of PDB equilibration time before returning to the Moses Lake site for groundwater sample collection per established PDB guidance. During this event, both sampling teams worked to collect the PDB samples as described in Section 2.5.3. PDB retrieval and sampling consisted of the following procedures:

1. The team verified each monitoring well location and identification number with project maps and the sample matrix. They verified work can proceed safely in the vicinity of moving vehicular traffic as required. The PDBs were prepared over clean sheets of aluminum foil prior to being placed into each well. The team used a pry bar, socket wrench or pinhead hex wrench as needed to open each flush mount monitoring well cover plate, and a Masterlock #485 padlock key for the standard "stick-up" monitoring well completions. The team donned new Nitrile gloves for groundwater sample collection.

2. The team carefully hauled each weighted PDB to the surface using the nylon suspension line. The sampling team carefully cut the top corner off each PDB and filled each sample vial. The team filled each vial just to overflowing and maintained a reverse meniscus. There was no down time once the PDB has been brought to the surface until sample collection was complete at each well. Any residual sample water in the used PDBs was discharged to ground surface.

3. Each PDB represented a unique sample ID number based on the well ID (and sample interval if two PDBs are deployed into one well). With the exception of the MS/MSD, all QC samples were submitted "blind" to the laboratory using a separate unique sample ID number not labeled as duplicate or trip blank per USACE standard sampling procedure. One set of trip blanks were required and included per sample shipping cooler. An extra laboratory-prepared PDB was shipped to the site and was used for collection of the trip and field blanks at the direction of the USACE project chemist.

4. Once recovered and sampled, the empty PDBs and suspension lines were discarded as non-hazardous municipal waste. In addition, gloves, paper towels, bags, and other solid waste materials were disposed of as municipal waste. The PDBs and other solid waste material were placed into a large plastic garbage bag and tied securely prior to disposal. The stainless steel weights were decontaminated and returned to the Seattle District, USACE office.

5. Finally, the team securely capped and locked each monitoring well riser and cover plate when finished.

2.5 Sampling Event Activities and Observations

2.5.1 Team 1 Monitoring Well Bladder Pump Sampling

Groundwater sample collection commenced immediately after achieving stabilization of water quality parameters during low flow purging at each well using dedicated bladder pump systems as described previously. The team worked from the far north end of the Site, moving to the far south end sampling each designated well as it was encountered. The project well maps and sample matrix were used to ensure samples were collected at the correct locations. The team used three 15 lb. compressed CO_2 cylinders acquired from Oxarc in Moses Lake to drive the pump systems, airlines, pump controllers, and flow cells to conduct the sampling of dedicated bladder pumps.

During the May 2016 sampling event, Team 1collected groundwater samples from a pre-determined set of 40 monitoring wells fitted with dedicated bladder pumps.

Even though a right of entry permit has been signed, and verbal or written permission granted to collect samples at each designated monitoring well, the sampling team always attempted to contact the property owner for each monitoring well location before beginning the field sampling activities.

Per agreement with Grant County Airport security, Joseph Marsh used his ramp security badge to access all monitoring wells within the restricted area without an escort.

Team 1 worked to measure static water levels in all designated project monitoring wells before completing the sampling event.

Other than property owner notifications, no special access procedures were required for any of the other bladder pump monitoring wells sampled during this event.

Prior to sample collection, the samplers donned protective eyewear and new, clean, Nitrile gloves to prevent exposure to contaminants and cross-contamination. All sample containers were filled immediately following low-flow purging by disconnecting the flow-through cell from the pump tubing system, and capturing pumped groundwater directly from the discharge end of the pump tubing. During sample collection, physical observations were recorded in the Micro-purge/Low-Flow Sampling Log data forms.

Stabilization of water quality parameters during purging occurred within six minutes during this event. Measured temperatures ranged from 13.88°C at well 91BW04 to 17.18°C at well 02BW02. Specific conductivity ranged from 0.20mS/cm (well 00BW03) to 0.62 mS/cm (well 00BW02). Dissolved oxygen measurements ranged from a low 0.85 ppm (well 91AW15) to 9.63 ppm (well 92BW01). PH values ranged from 6.99 units (well 92BW01) to 7.85 units (well 99BW15). Oxygen reduction potential ranged from 161 mV (well 00BW05) to 600 mV (well 99BW14).

Significant Observations Made During Team 1 Bladder Pump Sampling

Team 1 met with the manager of Airport Mini-Storage (8524 Broad Street, NE, Moses Lake) while conducting sampling activities. She asked for more project information, and the team handed her a project information sheet.

00BW14 – debris filling bottom of deep vault – had to clean out to open well cover.
00BW07 – is now located behind a new Genie fence and gate. Gate is usually open, but may have to contact Genie security for access in the future.
00BW04 – total depth of well converted to flush mount by contractors = 81.45’ bgs.
Met with local resident Doug Bierman who was curious about the project, and asked if we could sample his private well. We handed him a project information sheet and told him we would follow up with EPA and get back to him.

No other significant observations were made during this event.

2.5.2 Team 2 and 3 Private Well and WHF System Sampling

During the period of 16-18 May 2016, Team 2 collected groundwater samples from 4 WHF systems, and 28 private well systems. During that same time period, Team 3 collected groundwater samples from 6 whole house filter well systems, and 31 private well systems.

All required 40 ml VOA sample vials were obtained from Vendor ESS by the USACE contract lab ARI, and delivered to USACE pre-preserved with maleic and ascorbic acid.

Trip blanks were sent inside each sample shipping cooler delivered to the analytical lab.

Upon arrival at each private well property designated for sample collection, the team verified they were at the correct address using maps, notes, and the sampling matrix, and verified through field documentation they were ready to collect samples at the correct sampling point (hose bib, or suitable water discharge port nearest to the wellhead. The team always attempted to contact the owner or resident at each private well location before beginning the field sampling activities.

Per modified SOP, sampling point valves were opened, and water allowed to flow at approximately 0.5 to 1 gpm into a capture bucket. Next, water temperature readings were measured every two minutes until stabilization was achieved. During the May sampling event, water temperature stabilization ranged from 4 to 12 minutes elapsed purging time with most locations reaching stabilization within six minutes as shown in Table 1 below.

Table 1: Private Well Stabilized Water Temperatures and Purge Times

Well Location ID	Stable Temp. °C	Total Purge Time (Minutes)
WP-03	15.7	6
WP-04	Note A	Note A
WP-09	16.2	12
WP-10	17.5	6
WP-14	19.5	6
WP-27	16.7	6
WP-28	18.3	6
WP-33	15.8	6

WP-45	20.4	6
WP-50	16.1	6
WP-52	16.2	8
WP-54	15.9	6
WP-65	Note A1	Note A1
WP-57	15.5	6
WP-66	16.2	6
WP-68	17.2	6
WP-69	17.3	4
WP-70	15.1	6
WP-71A	16.1	6
WP-71B	17.3	6
WP-74	18.3	6
WP-82	15.1	8
WP-83	16.2	6
WP-86	16.2	6
WP-103	16.4	6
WP-105	17.7	6
WP-111	16.3	6
WP-116	17.8	6
WP-119	16.6	6
WP-120	15.7	6
WP-121	17.6	6
WP-122	17.0	8

WP-123	16.0	6
WP-124	17.2	6
WP-125	17.6	2
WP-126	17.4	6
WP-127	16.0	6
WP-128	15.6	6
WP-129	15.4	10
WP-130	18.4	6
WP-131	17.9	4
WP-136	17.4	4
WP-137	18.0	2
WP-139	18.5	10
WP-143	Note A2	Note A2
WP-144	17.5	6
WP-145	15.7	6
WP-147	16.4	6
WP-148	16.2	6
WP-149	16.0	6
WP-150	17.7	6
WP-152	Note A3	Note A3
WP-154	17.7	6
WP-155	17.5	6
WP-156	16.4	6
WP-164	15.5	6

WP-165	Note A4	Note A4
WP-167	15.9	6
WP-168	16.4	6
WP-170	15.1	6
WP-171	15.3	14
WP-172	17.5	6
WP-173	15.3	10
WP-177	15.3	2
WP-178	16.2	6
WP-179	23.5	10
WP-180	18.4	6

Notes:

Note A: Not Measured.
Note A1: Water collected through hose. Accurate water temperature reading not possible.
Note A2: No steady stream possible here. Purged 20 gallons, then collected sample.
Note A3: Physical site conditions prevented water temperature measurement.
Note A4: Additional piping at wellhead prevented accurate temperature readings.

Upon achieving stabilization, the final stabilized readings were entered into the project field book. Prior to collecting a water sample, the flow rate at each tap was reduced to approximately 100 to 200 ml/min. to minimize sample aeration and turbulence. The sampling team donned new Nitrile gloves prior to sample collection at each residence. In the case of the WHF sample ports, restrictors on the sample ports provided a stream of sample water at approximately 150 to 200 ml/min. All sample containers were be filled with water directly from each tap – forming a meniscus at the top of each vial to provide zero headspace samples as required. A photographic record of each sample point was made by the team.

Significant observations made during Private Well/WHF Sampling (Teams 2 and 3)

Non-Potable Water warning signs deployed at WP-04 and WP-125.
Owner at WP-11 refused sample collection. Unknown if owner will allow sampling next year until we contact (b) (6) o find out.
WP-121 had strange odors (b) (6) team collected a field blank in that area.
WP-154 and WP-156 – equipment blanks collected.

WP-65 and WP-68 – Teflon sample tubing used due to splitters and other unusual conditions at sample points.
(b) (6) WP-128. No samples collected until later when the owners returned to the house.

No other significant observations were made during this event.

2.5.3 Passive Diffusion Bag Sampling and Deployment

Team 1 performed all of the required PDB sample collection activities at the 36 pre-designated PDB wells during the May 2016 event.

All required 40 ml amber glass VOA sample vials were obtained from Vendor ESS (certified new, clean, QC Class) by the USACE contract lab ARI, and delivered to USACE pre-preserved with maleic and ascorbic acid.

The teams first verified each monitoring well location and identification number with project maps and the sample matrix. The teams also verified that work could proceed safely in the vicinity of moving vehicular traffic or other physical, biological, or environmental hazards that may have been present near each monitoring well.

Each team member donned new Nitrile gloves for groundwater sample collection at each well. Once the wells were unlocked and opened, one team member lifted the well riser plug and began hauling the PDB vertically to the surface.

Once each PDB was raised to the surface, the sampling team worked together to carefully cut the top corner off each bag using decontaminated steel scissors. Next, one person held the open sample vials and the other carefully and slowly tilted the bags - open side down - toward each open sample vial. The pre-preserved vials were filled just to overflowing to maintain a reverse meniscus. Then the vials were immediately capped making sure there were no bubbles or headspace per standard VOC sampling procedure. This entire sampling process can be completed within one minute to minimize loss of volatiles while preventing introduction of contaminants into the water from surface sources. After all required vials were filled; any residual sample water remaining in the used PDBs was discharged to ground surface. Therefore, no Investigation-derived waste (IDW) water was generated during this sampling event.

The sampling teams continued use of protective mesh PDB sleeves in wells with steel risers due to a greater potential for damage to the PDB membranes (monitoring wells 12EX01, 12EX02, 14EX03, 14EX04, and 14EX05).

Once recovered and sample water removed, the PDBs and suspension lines were discarded as non-hazardous municipal waste. In addition, gloves, paper towels, bags, and other solid waste materials were disposed of as municipal waste. The PDBs and other solid waste material were placed into a large plastic garbage bag and tied securely prior to disposal. The stainless steel weights were decontaminated and reused during the deployment of the new pre-filled PDBs for the next sampling event.

Significant Observations Made During Passive Diffusion Bag Sampling

Flush mount well vaults 12CW05, 12BW08, and 12EX02 were all flooded and had to be bailed out with a hand pump to access the well risers for sample collection.

Numerous rust particles were observed on the PDBs and PDB suspension lines installed in wells 14EX03 and 14EX04.

No other significant observations were made during this event.

3.0 INVESTIGATION-DERIVED WASTE

No investigation-derived waste was generated during this sampling event. All residual PDB water or purged well water was transferred directly to ground surface on each property away from the sample collection point.

4.0 SAMPLE PACKAGING AND DELIVERY

As mentioned in the narrative of each sampling event, groundwater samples were packaged in shipping coolers on ice and under chain of custody for overnight shipment to the USACE contract laboratory Analytical Resources, Inc. during the course of the sampling event.

All sample shipping coolers were prepared for laboratory delivery in the following manner: Each cooler was lined (sides and bottom) with plastic “bubble-wrap” sheets for shock absorption. A large 30-gallon plastic garbage bag was then placed into the cooler to contain the sample water in the event of container breakage during shipment to the laboratories. The glass sample vials were labeled, placed into plastic zip-seal bags, and placed into foam shipping blocks or bubble-wrap bags for shock protection. All the samples were placed in the shipping coolers as indicated on the corresponding chain of custody forms. Gallon size plastic zipper bags of cubed ice bags were placed between and on top of the samples in each cooler to ensure maintenance of the required four degrees Celsius (plus/minus two degrees) sample preservation temperature. The completed chain of custody (COC) forms were placed in gallon size plastic zipper bags and taped to the inside of each cooler lid. Two custody seals were affixed to the outside of each cooler. The custody seals were placed so that the coolers could not be opened without breaking the seals. Each cooler was then securely sealed with fiber tape. The field team ensured drain plugs were securely taped inside and out to prevent possible water leakage.

The laboratory was informed of the sample delivery and ensured the samples were properly accepted and checked in upon receipt the following morning after the sample containers were shipped. All sample coolers and sample containers were accounted for at the contract laboratory following each shipment.

5.0 LABORATORY ANALYSIS

Chemical analyses performed on the samples were as follows: VOCs (Method 524.3).
Additional Analyses: For this event, the teams collected 1,4 Dioxane and Perfluorinated Compounds samples for analysis at pre-determined wells in addition to the standard VOC samples.

The teams collected samples for **1,4 Dioxane** analysis at two WHF locations (WP-121, WP-125), 6 private wells (WP-25, WP-69, WP-74, WP-144, WP-168, and WP-175), 7 bladder pump wells (00BW10, 00BW12, 00BW15, 99BW01, 99BW12, 99BW15, and 99BW16), and 5 PDB wells (04BW05, 12BW07, 14BW01, 12BW02, and 02BW01).

The teams collected samples for **Perfluorinated Compounds** analysis at 4 WHF locations

(WP-119, WP-121, WP-124, and WP-125), 3 bladder pump wells (99AW10, 99BW16, and 91AW14), and two PDB wells (04BW04, and 04CW01).

6.0 DECONTAMINATION PROCEDURES

PDB weights, flow cells and associated tubing, water level indicator meters, and water volume measurement containers used by each team were decontaminated at the end of the project with an Alconox®-water solution followed by triple rinsing using distilled water in the USACE Geology Laboratory.

7.0 PROTECTION LEVEL

All sampling activities were conducted under Worker Protection Level D. For this project, personnel protective equipment included reflective safety vests, safety splash protection glasses, Nitrile gloves, and safety steel toe boots. New pairs of Nitrile gloves were donned prior to handling acid-preserved sample containers and between each unique private well sample point or monitoring well.

End of Field Sampling Report

APPENDIX A

Site and Well Location Maps

(Available in USACE Project Files)

APPENDIX B

Field Sampling Photos

(Available in USACE Project Files)

APPENDIX C

Field Notes

(Micropurge Logs Available in USACE Project Files)

Moses Lake Wellfield
Groundwater sampling table
TEAM 1: Joseph Marsh, Matthew Brakshier
MAY 2016 event – Monitoring wells

WELL	SAMPLE ID	SAMPLE DATE	TIME	VOCs	DRO	GRO BTEX
00BW09	1605N00BW09	5-16	0910	3	-	-
00BW14	1605N00BW14	5-16	1002	3	-	-
00BW01	1605N00BW01	5-16	1040	3	-	-
01BW01	1605N01BW01	5-16	1235	3	-	-
04BW01	1605N04BW01	5-16	1207	3	-	-
00BW05	1605N00BW05	5-16	1315	9	-	-
00BW05 FD	1605D00BW05	5-16	1330	3	-	-
00BW04	1605N00BW04	5-16	1350	3	-	-
00BW03	1605N00BW03	5-17	0855	3	-	-
00BW02	1605N00BW02	5-17	0926	3	-	-
00BW11	1605N00BW11	5-17	1015	3	~~8~~ 4	~~3~~ 9
91AW15	1605N91AW15	5-17	1047	3	-	-
91BW02	1605N91BW02	5-17	1205	3	-	-
~~Trip Blanks~~	~~1605TB00BW11~~	—	—	~~*3~~	-	~~3~~
Trip Blanks	1605TB01	5-17	1030	2	-	3

*Samples shown on this page represent samples on COC1 Shipped in Cooler 1.

Airbill: 8055 1111 8694
Shipped: 1400 hrs.

Moses Lake Wellfield
MAY 2016 EVENT TEAM 1
SAMPLE TABLE CONT.

Field Notes Begin on pg. 77

WELL	SAMPLE ID	SAMPLE DATE	TIME	VOCs	1,4 DIOXANE	PERFLUORINATED COMPOUNDS	DRO	GRO BTEX
00BW06	1605N00BW06	5-17	1302	3	-	-	-	-
00BW07	1605N00BW07	5-17	1433	3	-	-	-	-
91AW14	1605N91AW14	5-18	0900	3	-	2	-	-
99BW16	1605N99BW16	5-18	0927	3	1	2	-	-
04BW04	1605N04BW04	5-18	~~1012~~ 1150	3	-	2	-	-
04CW01	1605N04CW01	5-18	~~1050~~ 1012	9	-	6	-	-
04CW01 FD	1605D04CW01	5-18	1030	3	-	2	-	-
00BW12	1605N00BW12	5-18	1420	3	1	-	-	-
99BW15	1605N99BW15	5-18	1328	3	1	-	-	-
Field Blank	1605FB0191AW14	5-18	0900	-	-	1	-	-
Field Blank	1605FB0299BW16	5-18	0927	-	-	1	-	-
Field Blank	1605FB0304BW04	5-18	1150	-	-	1	-	-
Field Blank	1605FB0404CW01	5-18	1012	-	-	1	-	-
Trip Blank	1605TB02	5-18	0900	2	-	-	-	3
⊗ 00BW11	1605D00BW11	~~5-18~~ 5-17	1038	-	-	-	2	3

* Field Blanks associated with PFC wells

* Samples shown on this page represent COC2 - shipped in COOLER 2

⊗ Added 00BW11 DRO - GRO/BTEX Field Duplicate

Airbill: 8075 8549 3388
Shipped: 1530 hrs.

MAY 2016

MOSES LAKE WELLFIELD
MAY 2016 EVENT TEAM 1
SAMPLING TABLE continued...

WELL	SAMPLE ID	SAMPLE DATE	TIME	VOCs	1,4-DIOXANE
04BW05	1605N04BW05	5-19	0841	3	1
99BW01	1605N99BW01	5-19	1102	3	1
00BW15	1605N00BW15	5-19	1025	3	1
99BW12	1605N99BW12	5-19	1338	3	1
99BW12	1605D99BW12	5-19	1345	3	-
12BW07	1605N12BW07	5-19	1245	3	1
14BW01	1605N14BW01	5-19	1212	3	1
Trip Blank	1605TB03	5-19	1235	2	-

* samples on this page represent Samples on COC 3 shipped in Cooler 3.

AIRBILL: 8075 8543 3377
Shipped: 1445 Hrs.

MOSES LAKE WELLFIELD
MAY 2016 EVENT - TEAM 1
SAMPLING TABLE continued...

WELL	SAMPLE ID	SAMPLE DATE	TIME	VOCs	1,4-DIOXANE
04CW02	1605N04CW02	5-19	1446	3	1
91AW17	1605N91AW17	5-19	0942	3	-
12BW02	1605N12BW02	5-20	0835	3	1
02BW01	1605N02BW01	5-20	0926	3	1
02BW01	1605D02BW01	5-20	0940	3	-
00BW10	1605N00BW10	5-20	1017	3	1
Trip Blank	1605TB04	5-20	0900	2	-

* samples on this page represent Samples on COC 4 Shipped in Cooler 4.

Airbill: 8075 8543 3355
Shipped:

MOSES LAKE WELLFIELD
MAY 2016 EVENT -- TEAM 1
SAMPLE TABLE Continued...

WELL	SAMPLE ~~WELL~~ ID	SAMPLE DATE	TIME	VOCs	
04BW06	1605N04BW06	5-20	1235	3	
91AW09	1605N91AW09	5-20	1300	3	
91BW03	1605N91BW03	5-20	1332	3	
99AW08	1605N99AW08	5-20	1510	3	
02BW02	1605N02BW02	5-20	1445	3	
99BW14	1605N99BW14	5-21	0844	3	
04CW03	1605N04CW03	5-21	0906	3	
99AW01	1605N99AW01	5-21	0932	3	
91AW07	1605N91AW07	5-21	1006	3	
00AW11	1605N00AW11	5-21	1308	3	
92BW01	1605N92BW01	5-21	1235	9	MS MSD
92BW01 FD	1605D92BW01	5-21	1244	3	
92BW02	1605N92BW02	5-21	1340	3	
99BW09	1605N99BW09	5-21	1437	3	
Trip Blank	1605TB05	5-21	1100	2	

* Samples on this page represent
Samples on COC 5 shipped
in Cooler 5.
AIRBILL: 8075 8543 3366
shipped: 5-23-16

MOSES LAKE WELLFIELD
MAY 2016 EVENT - TEAM 1
Sample Table Cont.

WELL	SAMPLE ID	Sample DATE	TIME	VOCs	
91BW04	1605N91BW04	5-22	0844	3	
12BW01	1605N12BW01	5-22	0900	3	
00BW13	1605N00BW13	5-22	0927	3	
12CW04	1605N12CW04	5-22	1158	3	
12BW05	1605N12BW05	5-22	1206	3	
04CW05	1605N04CW05	5-22	1215	3	
04CW05 FD	1605D04CW05	5-22	1228	3	Field Dupe
12EX01	1605N12EX01	5-22	1234	3	
04BW09	1605N04BW09	5-22	1250	3	
14BW03	1605N14BW03	5-22	1302	3	
14EX05	1605N14EX05	5-22	1314	3	
12CW03	1605N12CW03	5-22	1352	3	
12BW04A	1605N12BW04A	5-22	1401	3	
12BW04B	1605N12BW04B	5-22	1405	3	
Trip Blank	1605TB06	5-22	1030	~~3~~ 2	

* Samples on this page represent
Samples on COC 6 shipped
in Cooler 6
AIRBILL: 8075 8543 3366
Shipped: 5-23-16

Moses Lake Wellfield
May 2016 event, Team 1

WELL	SAMPLE ID	DATE	TIME	VOCs
04BW07	1605N04BW07	5-22	1416	3
04CW04	1605N04CW04	5-22	1422	3
14EX03	1605N14EX03	5-22	1455	9 7
14EX03	1605D14EX03	5-22	1512	3
14BW02	1605N14BW02	5-22	1522	3
14EX04	1605N14EX04	5-22	1530	3
12CW02	1605N12CW02	5-22	1542	3
12BW03A	1605N12BW03A	5-22	1550	3
12BW03B	1605N12BW03B	5-22	1555	3
00BW16	1605N00BW16	5-23	0855	3
00BW16	1605D00BW16	5-23	0910	3
99AW09	1605D99AW09	5-23	0955	3
Trip Blank	1605TB07	5-23	0800	2

* extra Vol. for MS/MSD

* samples on this page represent samples on COC 7, shipped in Cooler 7.

AIRBILL: 8075 8543 3566
Shipped 5-23-16

* 2 MS
2 MSD
due to lack of volume

Moses Lake Wellfield
May 2016 Event
Team 1
Sample table, Cont.

WELL	SAMPLE ID	SAMPLE DATE	TIME	VOCs
99BW18	1605N99BW18	5-23	0932	3
12BW06	1605N12BW06	5-23	1112	3
12CW05	1605N12CW05	5-23	1132	3
12BW08	1605N12BW08	5-23	1310	3
12EX02	1605N12EX02	5-23	1257	3
12CW01	1605N12CW01	5-23	1326	3
99BW10	1605N99BW10	5-23	1550	3
04CW07A	1605N04CW07A	5-23	1410	3
04CW07B	1605N04CW07B	5-23	1412	3
99BW11	1605N99BW11	5-23	~~1549~~ 1600	3
04CW08	1605N04CW08	5-23	1505	3
Trip Blank	1605TB08	5-23	1015	2

* samples on this page represent samples on COC 8 and shipped in Cooler 8.

Airbill: 8075 8543 3344
Shipped: 5-23-16

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MOSES LAKE WELLFIELD
MAY 2016 EVENT TEAM 1

Field Activity Notes

0730 - calibrated flow cell, prepped supplies - Bought ice for cooling samples + pickedup CO_2 -

0835 Checked in with Genie Staff

0849 Setup @ 00BW09 - pre purging
SWL = 69.91' micropurge to Stabilization - water clear, NSTR -

0910 Sample time, close + lock well
Mob to CDS1 - 00BW14 in vault
Some sediment + debris in vault
prepurging, then micropurge to stability. NSTR - site hazardous due to surface wastes + traffic (garbage trucks + forklifts). Close up well - Bolt cover plate + replace Manhole covers. Mob out of CDS1 + to next well in field - 00BW01
SWL 45.29' pre purging then Micropurge to stability

1040 = Sample time, NSTR, close + lock well. Mob. to Lunch - 1115 - 1145

1158 Setup @ 04BW01 - PDB well
SWL = 63.87
Sample time - VOCs from PDB

New PDB not replaced until August

Moses Lake Wellfield
Field Notes continued
5-16-16

04BW01 continued - New PDBs
to be deployed in August
1207 - sample time
close + lock well, mob to
1214 - OIBW01 setup, pre-purging
and micropurge to stability. NSTR
1235 = Sample time, close, secure well
(flush mount) Mob. to 00BW05
00BW05 SWL = 63.91'
stick up well pre-purging, micropurge
to stabilization, NSTR
1315 = Sample time, Close + lock well
1330 = Field dupe time ~~[illegible]~~ Then
Mob. 00BW04 SWL = ~62.65'
↳ No pump. using Discrete
interval Bailer Sampling device.
1350 = sample time, close - secure
flush mount well cover
All samples collected today have been
labeled, bagged, and packed on ice
in sample cooler - to be held overnight
under chain of custody in hotel room.
- Team inspects well site at 00BW07
and discovers gate and fence now surround
the monitoring well as part of Genie
property - must coordinate with Genie
for access to well.

Moses Lake Wellfield Field Notes
5-16-16
5-17-16
1630 - end of day 1.
[signature]

5-17-16
0730 - Buying ice - calibrated flow cell
equipment ready for sampling
0822 - Setup @ 00BW03 SWL 82.28'
pre purge then micropurge to
Stability - NSTR - clear water
0855 = Sample time, close + lock well
mob. to 00BW02 open well
(sticky cover) SWL = 85.32'
pre purge - Micropurge to stability
0926 - Sample time, close + lock well
NSTR.
Setting up at 00BW11 and 91AW15
simultaneously. SWL - 00BW11 = 91.32
91AW15 SWL = 91.64'

1015 = 00BW11 (P) Sample Time 1038 (FD) Sample Time
close - secure well.
purging - micropurge @ 91AW15
clear NSTR
1047 - sample time, close, lock well →

Moses Lake Well field

5-17-16 Team 1 Notes

1155 - 91BW02 - setup - No pump
Should be diffusion bag
- will use discrete interval
Sampler to recover VOC sample
SWL = ~~99~~ 91.55'
1205 = Sample time close up well.
~~Mob. to~~ SWL @ 00BW08 = 90.17'
Mob. to 00BW06
SWL = 148.0' pre purging
Then Micropurge to Stability
1302 - Sample time, close ~~lock~~ Lock
well, Depart Airport for
FEDEX to ship cooler 1.

1400 - Shipped 1 cooler (ARI) Via Grant County Airport

- Talked to facility Manager
at Genie - Nick Womack
setup ok @ 00BW07 No Safety concerns today
pre purged + Micropurge to Stability
1433 - Sample time, close + lock well
* Note: Location now on Genie property
Mob. back to 00BW04 to sound
well + ~~determine~~ PDB placement
depth in August 81.59' Top of PVC To Bottom

Moses Lake Well field
Team 1 May 2016

81.59
− 0.14 instrument point
81.45 00BW04 TOTAL Depth
* set PDB @ approx. 75' Below Top of
riser in future.

5-18-16
0730 - Calibrated flow cell, prepped
equipment for sampling - bought ice

0830 - Setup @ 91AW14, SWL = 122.27'
Pre purging + Micropurge to Stability.
Sampling VOCs + PFC here. NSTR
0900 sample time, Close + lock well, mob to 99BW16
opening well Both in pair have Bladder pumps
99BW16 SWL = 122.96'
prepurging, then micropurge to stability
0927 = Sample time, VOCs, 1,4-Dioxane, PFC
Close + lock well.
04BW04 PDB well, SWL = 137.01'
04CW01 ~~04CW04~~ PDB well SWL: 163.24'
04BW04 + 04CW01 Sampled by PDB + Discrete
Interval Samplers, close-lock well
04CW01 ~~04CW04~~ sample times (P) 1012
(FD) 1030

2015

Moses Lake Wellfield
May 2016 Field Notes

(b) (6) [redacted]

Rd. E.7

5-18-16
Approached by citizens
Discussed project + Requested Sampling at (b) (6) [redacted] home,
*provided project information sheet to (b) (6) [redacted]

1150 = 04BW04 sample time PDB
close/lock well

1303 – setup at 99BW15
pre purging Bladder pump well – flush mount, micropurge to stability NSTR
1328 = Sample time, close up, secure well
Mob. to Airport 00BW12
Prepurging, then micropurge to Stabilization, NSTR
1420 = Sample time, close/lock well
Depart restricted Airfield property for Fedex station at airport
1530 – One cooler shipped to ARL

1600 Recon. for tomorrows wells.
1630 – end of day

[signature]

Moses Lake Wellfield
May 2016 Field Notes Team 1

5-19-16
0730 – calibrate flowcell – buy ice, prep supplies.

0823 – 04BW05 SWL 129.17'
pulled one PDB + used one new discrete interval sampler to collect samples. NSTR
0841 – Sample time, close + lock well, will Mob. to 91AW17 next due to City request that we not work there later than today.

0921 91AW17 Schedule change
SWL = 117.01', pre purging then micropurge to stability
0942 – Sample time, Close + lock well
Mob. to 00BW15 SWL = 77.62'
pre purging – dedicated Bladder pump micropurge to stability
1025 Sample time, close + Lock well
Mob. to 99BW01 SWL = 88.22'
prepurge then micropurge to stability
1102 = Sample time, close/lock well
Lunch

Setup at 14BW01 PDB well SWL = 94.47'
1212 = Sample time, close + lock well

5-19-16 Moses Lake Wellfield
Team 1 MAY 2016

1236 = Setup @ 12BW07 SWL = 88.23'
PDB Well
1245 = Sample time, close + lock well.

1317 - 99BW12 setup - prepurge
Micropurge to stability, NSTR.
1338 - Sample time, close + lock
well. (Bentonite slightly swelling
in vault as per normal function)
* FD Time 1345.

- Ship 1 cooler via Fedex to ARI.

04CW02 setup for PDB sampling
VOC only SWL = 162.40'
1446 = Sample time
close + lock well, NSTR

site inspection, purchasing supplies
1600 end of Day

5-20-16
0730 - calibrate flow cell, buy ice, prep supplies
0820 - Setup 12BW12 PDB well SWL = 118.69'
0835 - Sample time, close, secure well.

Team 1 Moses Lake Wellfield
5-20-16 cont.

0900 - Mob. to 02BW01
SWL = 133.85'
collecting samples using PDB
+ Dedicated Sampling device,
0926 = Sample time (P) 0940 (FD)
retrieving lost sampling device in well
close + lock well.

Setup at 00BW10 at church parking lot
SWL = 143.40' Bladder pump well.
Pre-purging, Then Micropurge to
Stability. Higher than normal gas
pressure used ~~to~~ due to well depth
1017 = Sample time -
Close - secure well.

1130 Ship one cooler (#14)
to ARI via Grant County
Intl Airport Fedex.

1145 - 1215 Lunch

1220 - Setup at 04BW06 PDB well
SWL = 104.57' NSTR
1235 = Sample time Close + lock well

Moses Lake Wellfield

5-20-16

1240 - Setup @ 91AW09 SWL = 86.74'
pre-purging, then micropurge to stabilization, well pad undermined by rodents.
1300 = Sample time, close + lock well.
Mob. to 91BW03.
pre-purging - deep pump - near operating limits. SWL = 88.05'
Micropurge to stability
1332 = Sample time, close + lock well

1427 at ~~02W~~ 02BW02 SWL 67.04'
(Picked up 2 ea CO_2 bottles
1 CO15, 1 CO5.
prepurging
Micropurge to stability
1445 = Sample time, close + Secure well
Mob. over to adjacent well
99AW08 - opened up - vault full of cobwebs. SWL = 67.59'
pre purging, then micropurge to stability - NSTR
1510 = Sample time close + lock well

1600 - end of field day

Moses Lake Wellfield
Team 1 May 2016

5-21-16

0730 - calibrate flow cell - buy ice
Prep supplies
Setup at 99BW14, pre purging → High ORP.
then micropurge to stabilization
0844 = Sample time, close + lock well
setup @ 04CW03 PDB well -
0906 = pulled + sample time, closed + locked SWL = ~~149~~ 149.52'
Mob. to 99AW01 pre purging
Micropurge to stability.
0932 = Sample time, close + lock well.
Mob to 91AW07 SWL = 86.72'
PDB well.
1006 = Sample time, well closed + locked
No significant problems this morning
1100-1130 Lunch

1204 Setup @ 92BW01 SWL = 83.31'
prepurge, then micropurge to stability
1235 = Sample time (P) 1244 (FD)
Close / lock well.
Mob. to 00AW11 SWL = 83.18'
pre-purging then Micropurge to stability
1308 = Sample time, close + lock well.

Moses Lake Wellfield
Team 1

5-21-16

1322 mob to 92BW02 SWL = 80.72'
pre-purged, then micropurge to
Stability
1340 = Sample time, close + lock well
~~clos~~ mob. to 99BW09
1418 = setup at 99BW09, SWL = 77.39'
prepurging, then micropurge to
Stabilization
1437 = Sample time close + lock well,
Packed Samples, worked on equipment
1600 - end of day.
~~5-16~~ 5-22-16

0819 - setup at 91BW04 SWL = 83.36'
pre purge then micropurge to
Stability - High ORP - over 600 mV
0844 = Sample time, close - lock well ~~mV~~
Mob. to 12BW01 SWL = 83.42'
0900 = Sample time, close - lock well
00BW13 → SWL = 83.49'
prepurge + micropurge to Stability
= Sample time, Close - lock well

12CW04 SWL = 100.87'
1158 = sample time
12BW05 SWL = 88.93'
1206 = Sample time

Moses Lake Wellfield
TEAM 1

5-22-16
PDB wells cont.
1210 to ~~1215~~ → 04CW05 SWL = 98.55'
1215 = (P) Sample time 1228 = (FD) sample time
close + lock well. NITE mob →
12EX01 SWL = 83.16'
1234 = Sample time, close + lock well mob to →

1247 04BW09 → SWL = 83.86'
flush mount - mites - insects in well
1250 = Sample time, close/secure well.
Setup @ 14BW03 SWL = 86.17'
1302 = Sample time

Setup at 14EX05 SWL = 96.09'
1314 = Sample time. close/lock well
16CW03 SWL = 107.51
Sample Time = 1352 close/lock well

12BW04 SWL = 98.59'
1401 = "A" sample time,
1405 = "B" Sample time close/lock well
mob. to 04BW07 SWL = 125.47'
1416 = PDB well Sample time
close, lock well, mob to adjacent
PDB well 04CW04 SWL = 126.49'
1422 = Sample time, close/lock well

Moses Lake Wellfield
Team 1

5-22-16

Mob to 14EX03 SWL= 94.71'
PDB well –
Sample time (P) 1455 (FD) 1512
close + lock well. Note: due to
Narrow PDBs sent by Lab –
only 2 MS + 2 MSD Vials
could be collected with
P + FD Samples.

Mob. to 14BW02 SWL= 106.84'
1522 = PDB sample time, close + lock
well – at adjacent Ext. well
14EX04 SWL. 107.07'
1530 = PDB sample time, close-lock well
setup at
12CW02, SWL = 155.56'
1842 = PDB sample time, close/lock well
Mob. to South adjacent well 12BW03
SWL @ 12BW03 = 127.98'
1550 = "A" Sample time
1555 = "B" Sample time close/lock well
No significant problems today.
1600 end of day.

Moses Lake Well Field
Team 1

5-23-16

0730 – calibrated flow cell, buy ice,
Prep supplies.

Setup @ 00BW16
SWL= 136.07' Bladder pump
prepurge then Micropurge to stability
0855 Sample time: (P) 0910: (FD)
Close + secure well – Mob to –
0910 – 99BW18 SWL= 104.76'
Pre purge – then Micropurge to
Stability, NSTR
0932 = Sample time, close-lock well
Mob to 99AW09 SWL = 97.49'
pre purging, then Micropurge to stability
0955 = Sample time, close/lock well
Note: Soot from Airport fire training
in grass ~~on~~ across project – getting
on clothes + equipment, unknown impact.
Mob. to Fedex to ship coolers
5, 6, and 7.

Setup at
1102 – 12BW06, vault flooded – pumped out
into bucket to transfer into ditch
(Surface water) SWL= 117.47'
1112 PDB Sample time, well secured
Mob. to 12CW05 →

Moses Lake Wellfield
Team 1

5-23-16 continued
well 12CW05 setup - Vault flooded
SWL = 143.06' ↳ water disposed away from well,
1132 = Sample Time (PDB)
close - secure well No problems today,
1150
1220 - Lunch time

Mob. to 12BW08 SWL = 119.77'
(water removed from vault)
1310 = Sample time PDB well - close-secure well

Mob. to
12EX02 SWL = 119.88' water removed from vault
1257 = Sample time @ PDB well
close/secure vault cover plate
Mob. to 12CW01 - No water in vault -
SWL = 137.93'
1326 = Sample time @ PDB ~~Pen~~ well
close - secure well 15/16" Bolts
Back to Mini-Storage - gave manager Project sheet,
1402 Mob. to 04CW07 - dual interval
PDB well. SWL = 149.04' → NSTR
1410 "A" Sample time 1412 = "B" sample time
close + lock well - Mob. south to -
setup @ 99BW10 SWL = 133.06'
pre purging + Micropurge to
Stability → NSTR
1550 = Sample Time, close-lock well

Moses Lake Wellfield
TEAM 1
NOTES

5-23-16
Mob to well 04CW08 ~~SWL~~ =
1505 = PDB sample time (147.50' = SWL)
close-secure well,
Mob to 99BW11 SWL = 55.46'
prepurging + Micropurge to Stability
1600 = Sample time, close + lock well
No significant problems today
Sampling complete.
1620 final Sample Cooler Shipped to ARI
1630 - end of day;
Return to District Office
on 5-24-16

Location Moses Lake Date

Project / Client 2016 May Sampling

Sample ID	Date 2016	Time	VOC	Notes

Location Moses Lake Date

Project / Client 2016 May Sampling

Sample ID	Date 2016	Time	VOC	Notes

Location Moses lake Date 5/16
Project / Client May 2016 private wells

WP-03 left door hanger

Time	15.3	15.6	15.7	15.7
temp	0	2	4	6

purged 5 gal
sample N: 0845
D: 0830

WP-68 left door hanger

Time	0	2	4	6
Temp	17.2	17.2	17.2	17.2

purged 5 gal
large splitter connected so sample was taken using tube
sample time 0930

WP-116 left door hanger

Time	0	2	4	6
Temp	17.7	17.7	17.7	17.8

sample time 0945
purged 5 gal

WP-66 left door hanger sample 1010

time	0	2	4	6
Temp	16.1	16.2	16.3	16.2

purged 5 gal

Location Moses lake Date 5/16
Project / Client May 2016 private wells

WP-126 left door hanger

Time	0	2	4	6
Temp	17.[illegible]	17.5	17.5	17.4

purged 5 gal
air bubbles in tube
Sample time: 1030

WP-165
Take 15ft pipe and connect to outside pipe. then turn knob against wall until water is on. sample 1049

WP-130 left door hanger

Time	0	2	4	6
Temp	18.5	18.4	18.3	18.4

purged 5 gal
sample time 1130

WP-172

Time	0	2	4	6
temp	17.8	17.8	17.7	17.5

purged 5gal sample time 1200

Location Moses Lake Date 5/16

Project / Client May 2016

WP-136 door hanger

Time	0	2	4	6
Temp	17.4	17.2	17.4	

purged 5 gal

sample time 1216

WP-177

Time	0	2	4	6
Temp	15.1	15.3		

purged 5 gal

WP-65

Time	0	2	4	6
Temp				

Had to collect from hose

ran about 7 gal

Sample time 1420

WP-105 door hanger

Time	0	2	4	6
Temp	17.8	17.6	17.6	17.7

purged 8 gal

Location Moses Lake Date 5/16

Project / Client May 2016 private well

New ROE WP-152

Time	0	2	4	6
Temp				

5 gallons purged

sample 1541

* left door hanger at WP-71B

WP-10

spigot on northside of apartments

Time	temp
0	17.5
2	17.3
4	17.3
6	17.5

purged 5 at first then purged 10 gal total

sample time 1410

WP-155

Time	0	2	4	6
temp	17.6	17.6	17.6	17.5

purged 5 gal

sample time 1630

END DAY 1

Location Moses Lake Date 5/17

Project / Client May 2016
Private well sampling

WP-121 Totalizer: 68690

Time	0	2	4	6
Temp	17.6	17.6	17.4	17.6

WP-121A1: 0850
WP-121 C1: 0856

purged 5 gal
Garage had some odors maybe engine oil. Took one FB for PFC because locations are close

WP-119

Time	0	2	4	6
Temp	16.7	16.5	16.7	16.6

purged 10 gal temp started high dropped to 15.1 then stabilized

NWP ~~121~~ 119 A1 : 0930
DWP129A1 0938
NW~~WP~~P119C1 0945

Totalizer
108095.8

FB for PFC taken near davids person

Location Moses Lake Date 5/17

Project / Client May 2016
Private Well Sampling

WP-11 Refused sampling 1030
we offered (b) (6) the fact sheet and (b) (6) said (b) (6) has seen the website

WP-~~[illegible]~~ 27

Time	0	2	4	6
Temp	16.7	16.7	16.6	16.7

pump was running so there was air in line

sample time 1100

WP-28

Time	0	2	4	6
Temp	18.3	18.3	18.3	18.3

sample time 1120

Location Moses Lake Date 5/17
Project / Client May 2016 Sampling event

WP-04
sample time 1200
Hung non-potable sign at CWC on outside and one on well house. gave two signs to lady in office.

WP-131

sample time: 1330

temp	17.9	17.9	17.9	
time	0	2	4	6

water was sudsy at first
purged 10 gal

WP-125 totalizer 449537.5

Time	0	2	4	6
Temp	17.6	17.6		

Have contractor remov flow thing

Location Date
Project / Client

installed 2 signs for no drink.

NWP125A1 1400
NWP125B1 1406
NWP125C1 1411
1605FB WP125 1415

WP-137

Time	0	2	4	6
Temp	17.8	18.0		

purged 10 gal

End Day 2

Moses Lake 5/17/16
May 2016

WP-74

Time	0	2	4	6
Temp	18.3	18.3	18.3	18.3

air in line owner does't
need us to call sample anytime

sample time 0905

WP-71A

Time	0	2	4	6
Temp	16.1	16.1	16.1	16.1

water ~~was~~ pulsing and a
steddy stream was not possible.
see picture
sample time 0930

WP-57 left door hanger

Time	0	2	4	6
Temp	15.6	15.5	15.6	15.5

N: 0950
D: 1000
purged 5 gal

Moses Lake 5/17/16
May 2016

WP-144 left door hanger

Time	0	2	4	6
Temp	17.4	17.5	17.4	17.5

sampled from spigot in front.
purged 5 gal
sample time: 1015

WP-180

One well house two spigots
(b) (6) wasnt home so
neighbor let us sample out
of (b) (6)

Time	0	2	4	6
Temp	18.7	18.7	18.6	18.4

purged 5 gal

Sample time 1040

WP-124
Sample

time	0	2	4	6
Temp	17.2	17.2	17.3	17.2

purged 5 gal

Moses Lake

4D
3MS/MSD

WP124A1 1115
WP124C1 1120
totalizer 275513.0

160SFBWP124 1110

WP-69

Time	0	2	4	6
Temp	17.3	17.3	17.3	

purged 10 gal

Sample time 1203
Duplicate 1158

WP-52 Dioxane only

Time	0	2	4	6
Temp	17.8	17.8	17.7	17.6

only collecting ~~on~~ Dioxane in place of WR-175 because the water is turned off

Sample time 1412

WP-45

Time	0	2	4	6
Temp	20.0	20.1	20.2	20.4

purged 15 gal

N: 1450
D: 1500

Moses Lake

tart

ay 2016

illiams, Kinser

Well ID	Sample ID	Date	Sample	Notes
WP-179	1605NWP179	5/16/16 0855	P	—
WP-70	1605NWP70A1 " B1	" 0918 0922 0922	"	—
WP-123	1605NWP123A	" 0959	"	—
WP-129	1605NWP129	" " 1032	"	—
WP-120	1605NWP120	5/16 1042	P	—
WP-122	1605NWP122	5/16 1138	P	MS/MSD
WP-127	1605NWP127	5/16 1207	P	—
WP-138	1605NWP138	5/16 1259	P	—
WP-139	1605NWP139	5/16 1327	P	—
WP-143	1605NWP143	5/17 1527 ~~5/16~~	P	—
WP-178	1605NWP178	5/16 1445	P	—
WP-167	1605NWP167	5/16 1356	P	—
WP-168	1605NWP168 1605DWP168	5/16 1523 1526	P+FD	—
WP-156	1605NWP156	5/16 1717	P	—

Moses Lake

tart
ay 2016
illiams, Kinser

Well ID	Sample ID	Date	Sample	Notes
WP-179	1605NWP179	5/16/16 1355	P	—
WP-70	1605NWP70A " B	" 0918 0922	"	—
WP-123	1605NWP123A	" 0954	"	—
WP-129	1605NWP129	" 1032	"	—
WP-120	1605NWP120	5/16 1042	P	—
WP-122	1605NWP122	5/16 1136	P	MS/MSD
WP-127	1605NWP127	5/16 1207	P	—
WP-138	1605NWP138	5/16 1250	P	—
WP-139	1605NWP139	5/16 1327	P	—
WP-143	1605NWP143	5/17 1527	P	—
WP-178	1605NWP178	5/16 1445	P	—
WP-167	1605NWP167	5/16 1356	P	—
WP-168	1605NWP168 1605DWP168	5/16 1523 1526	P+FD	—
WP-156	1605NWP156	5/16 1717	P	—

Moses Lake 5/16/16

Sample ID	Date/Time		Sample	Notes
~~1605 NWP154~~				
1605NWP169	5/16	1628	P	—
1605NWP145	5/16	1655	P	—
1605NWP36	5/17	0842	P	—
1605NWP52 / 1605DUP52	5/17	1049 / 1052	P+FD	ms / msd
1605NWP54	5/17	1117	P	—
1605NWP09	5/17	1144	P	—
1605NWP147	5/17	1218	P	—
1605NWP50	5/17	1330	P	—
1605NWP83	5/17	1355	P	—
1605NWP82	5/17	1433	P	—
1605NWP128	5/17	1550	P	—
1605NWP150	5/17	1631	P	—
1605NWP149	5/17	[illegible]	P	—
1605NWP153 / 1605DUP153	5/18	0918 / 0922	P+FD	ms / msd
1605NWP154	5/18	0936	P	—
1605EBJWBL	5/18	0945	EB	—
1605NWP171	5/18	1032	P	—
1605NWP170	5/18	1051	P	—
1605NWP111 / 1605DUP111	5/18	1144 / 1146	P+FD	—
1605NWP33	5/18	1207	P	—
1605NWP173	5/18	1324	P	—
1605NWP14	5/18	1340	P	—

Moses Lake

WP-71B	1605NWP71B	5/18	1435	P	—
WP-148	1605NWP148	5/18	1620	P	—

Moses Lake
Private Wells / EPA 5/16/16
Samplers: Jake Williams & Blair Kinser

0815
Weather: Partly Cloudy
Temp: 54° F

Scope: Sampling at Moses Lake has been split between 3 teams. Our team is to collect water samples from private wells in the Moses Lake area. Wells are being sampled for VOCs, in particular TCE.

0835
Arrived @ (b) (6) [redacted] to sample WP-179.

Purge: 7 gallon total

	Time	Temp C°
0841	0	22.4
0843	2	22.4
0845	4	22.1
0847	6	23.4
0849	8	23.4
0851	10	23.5

Stable

Moses Lake 5/16/16
Private Wells / EPA

Samples collected @ 0851

- - - - - - - - - -

rived @ (b) (6) [redacted] @ 0905
to sample WP-70.

Totalizer Reading PrePurge:
~~2364.5~~ BCK
237064.5 BCK

ge with teflon line to reduce
spray & damage to electrical

Time	Min	Temp °C
0912	0	15.1 °C
0914	2	15.1 °C
0916	4	15.0 °C
0918	6	15.1 °C

Purged 3 gallons total

0918 Sampled port A
0920 Sampled port B
0922 Sampled port C

Moses Lake 5/16/16
Private Wells / EPA

Arrived @ (b) (6) [redacted] 0942
to sample WP-125

Time	Temp °C
0	16.7
2	16.1
4	16.0
6	16.0

Stable

WHF, totalizer: 204680.7
A port Sample: 0959

- - - - - - - - - -

Arrived @ (b) (6) [redacted] 1010
to sample WP 129
Purge @ front of house

Time	Minute	Temp °C
1015	0	20.1
1017	2	16.2
1019	4	15.7
1021	6	15.2

Cont'd next page

Moses Lake 5/16/16
Private Wells / EPA

Time	Minute	Temp °C
1023	8	15.3
1025	10	15.4 *
1027	12	N/A

* Stable temp.

Totalizer = ~~120799.9~~ 3ch → 120799.5

Sampled @ 1032

Arrived (b) (6)
WP-120 @ 1043

No one home, place doortag 1045
Sample from north spigot

Time	Temp
0	15.9
2	15.7
4	15.7
6	15.7

Moses Lake 5/16/16
Private Wells / EPA

Sample time: 1056

Arrived @ (b) (6) 1123
WP-122 ← to sample

Began purge 1129

Time	Minute	Temp
1129	0	16.9 °C
1131	2	16.8 °C
1133	4	17.1 °C
1135	6	17.1 °C
1137	8	17.0 °C

Stable

Purged 8 gallons

Began sample 1138

Moses Lake 5/16/16
Private Wells | EPA

Arrived @ (b) (6)
to sample WP-127 @ 1158

Time	Temp
0	16.5
2	16.0
4	16.0
6	16.0

Sample time: 1207

Lunch Break

Arrived @ WP-138 1245
(b) (6)

Time	Minute	Temp °C
1252	0	17.4
1254	2	17.1
1256	4	17.0
1258	6	17.0

Stable

Moses Lake 5/16/16
Private Wells | EPA

Sample Time 1259

Weather: Partly Cloudy
Temp: 68°

~~Arrived @~~ (b) (6) 1305 ~~WP-143~~ to sample WP-143

Not able to sample well b/c stopping piston valve from opening. Will get tools tonight to remove.

Arrived at WP-139 @ 1315

Time	Temp
0	17.8
2	18.0
4	18.1
6	18.3
8	18.4
10	18.5

Stable

Moses Lake 5/16/16
Private Wells | EPA

mple time: 1327

WP-143

he team was able to find an adjustable
ench to open the valve. When opened
water flowed the team is assuming
at the well is turned off @ this time.

Arrived @ (b) (6) [redacted] 1345
to sample WP-16~~8~~7 BCK

Purge - 4 gallons

me	Minute	Temp °C
349	0	16.0
351	2	15.8
353	4	15.8
355	6	15.7

Stable

Sample Time 1356

Moses Lake 5/16/16
Private Wells | EPA

Arrived @ (b) (6) [redacted] 1435
WP-178

Time	Temp C°
0	16.1
2	16.0
4	16.0
6	16.2

Sample time: 1445

Arrived @ (b) (6) [redacted] 1504
WP-168 ← to sample

Began Purge 1516

Time	Minute	Temp °C
1516	0	16.8
1518	2	16.9
1520	4	16.9
1522	6	16.9

Stable

Sample Time 1523 Dup 1526

Moses Lake 5/16/16
Private Wells | EPA

Arrived @ (b) (6) 1543
WP-154
Left a door tag to sample @ different time/day

Arrived @ (b) (6) 1602
to get right of Entry WP145

Arrived @ (b) (6) 1545
to get right of Entry

Arrived @ (b) (6) 1619
WP-164

Time	Temp
0	15.3
2	15.3
4	15.3
6	15.5

gal. purged

Sample Time 1628

Moses Lake 5/16/16
Private Wells | EPA
(b) (6) 1645

ROE Signed @ WP-145

Time	Temp
0	16.4
2	15.5
4	15.6
6	15.7

Sample time: 1655

Arrived @ (b) (6)
WP-156

Began Purge

Time	Min	Temp °C
1710	0	16.5 °C
1712	2	16.6 °C
1714	4	16.4 °C
1716	6	16.4 °C

Used equipment will need to take equipment blank

Moses Lake 5/17/16
Private Wells | EPA
End of - 5/16/16
Sample Time 1717

- - - - - - - - -

mplers : Jake Williams & Blair Kinser
5/17/16

Arrived @ (b) (6) [redacted] 08:24
WP-86

Time	Temp C°
0	16.4
2	16.4
4	16.3
6	16.2

Stable Purged ≈ 6 gallons

Sample time 8:42

talizer : 577,203.6

At 0900 Left for airport to ship samples from yesterday

Moses Lake 5/17/16
Private Wells / EPA

Completed Shipment of Samples @ 1017

- - - - - - - -

Arrived @ (b) (6) [redacted] 1032
~~WP-07~~ WP-52
BCN

Began Purge

Time	Minute	Temp (°C)
1038	0	14.6
1040	2	14.8
1042	4	16.0
1044	6	16.1
1046	8	16.2

Stable

Purged 8 gallons

Sample Time 1048
MS & MSD
Duplicate Sample Time 1052

No one home left door tag

Moses Lake 5/17/16
Private Wells | EPA

Arrived at (b) (6) [redacted] 1105
WP-54

Recieved ROE
Began Purge

Time	Temp
0	~~15.8~~ 15.8
2	15.9
4	15.9
6	15.9

• Stable
4 gal. purged
Sample time: 1117

Moses Lake 5/17/16
Private Wells | EPA

Arrived at (b) (6) [redacted] 1126
WP-09

Began Purge

Time	Minute	Temp °C
1130	0	17.7
1132	2	17.5
1134	4	17.4
1136	6	16.6
1138	8	16.1
1140	10	16.0
1142	12	16.2

No one home - left door tag

Stable

Purged 8 gallons

Sample time 1142

Moses Lake 5/17/16
Private Wells | EPA

Arrived at (b) (6) [redacted]
WP- 128

Tried sampling (b) (6) [redacted] - no samples were collect will wait when owners are home.

Arrived at (b) (6) [redacted]
WP - 147 1204

Time	Temp C°
0	16.3
2	16.3
4	16.4
6	16.4

Stable

Sample time 1218

Lunch

Moses Lake 5/17/16
Private Wells | EPA

Arrived (b) (6) [redacted] 1320
WP - 50

Time	Min	Temp C°
1323	0	16.2
1325	2	16.1
1327	4	16.1
1329	6	16.1

Stable

Purge 5 gallons

Sample Time 1330

No Answer @ door left door tag.

Moses Lake 5/17/16
Private Wells / EPA

Arrived @ (b) (6) [redacted] 1344
WP - 83

Time	Min	Temp °C
1348	0	16.5
1350	2	16.3
1352	4	16.2
1354	6	16.2

stable

Sample Time 1355

Arrived @ (b) (6) [redacted] 1420
WP-82

Time	Temp C°
0	16.2
2	15.9
4	15.3
6	15.2
8	15.1

13 gal. purged. stable

Moses Lake 5/17/16
Private Wells / EPA

Sample time: 1433

3-Flag Condos 1523
WP-143

No steady stream possible
Purged 20 gallon obtaining
sample ~~vea~~ via split apparatus.

Sample Time 1527

Arrived at (b) (6) [redacted] 1539
WP-128

Purge Time	Minute	Temp °C
1543	0	15.6
1545	2	15.6
1547	4	15.4
1549	6	15.6

Sample Time 1550

Moses Lake 5/17/16
Private Wells / EPA

d @ (b) (6) [redacted] 1601

Place Pre-sampling door hanger

d @ (b) (6) [redacted] 1612 WP-150

Time	Temp C°
0	17.8
2	17.7
4	17.7
6	17.7

Purged 4 gal

sample time: 1631

Moses Lake 5/17/16
Private Wells / EPA

Arrived at (b) (6) [redacted] 1645
WP-144

Purge

Time	Min	Temp
1645	0	15.8
1647	2	15.8
1644	4	16.0
1651	6	16.0

Moses Lake 5/18/16
Private Wells / EPA
Samplers: Jake Williams & Blair Kinser

Weather: Sunny
Temp: 66° F

Arrived at (b) (6) [redacted] 0847
WP-151

No water running from taps. Well was disconnected. No one was home. left tag at the door. (b) (6) [redacted]
(b) (6) [redacted]

Arrived at (b) (6) [redacted] 0905
WP-153

Began Purge

Time	Minute	Temp
0910	0	16.4
0912	2	16.4
0914	4	16.4
0916	6	16.4

Stable

Sample time 0918 includes MS/[illegible]
Dup Sample Time 0922

Moses Lake 5/18/16
Private Wells / EPA

Arrived at (b) (6) [redacted]
WP-154

Time	Temp
0	17.6
2	17.6
4	17.7
6	17.7

Sample time: 0936

Equipment Blank Taken 0945

Moses Lake 5/18/16
Private Wells | EPA

Arrived at (b) (6) [redacted] 1010
WP-171

Began Purge

Time	Minute	Temp
1012	0	15.1
1014	2	15.2
1016	4	15.3
1018	6	15.5
1020	8	15.7

New Well Coords
47° 9" 17" N 119° 19' 36" W
Well ID - ABP863
Well located in back of house
at (b) (6) [redacted] which is a (b) (6) [redacted] house.

1022	10	15.8
1024	12	15.4
1026	14	15.3
	15	Purged 10 gallons

Sample time 1032

Moses Lake 5/18/16
Private Wells | EPA

Noted Well @ (b) (6) [redacted]
Well ID ABP

Coords
47° ~~49~~ 9' 17" N 119° 19' 37"

Time	Minute	Temp
1043	0	14.7
1045	2	15.2
1047	4	15.1
1049	6	15.1

Purged 12 gallons
Stable

WP-170 ~~Assumed~~ 3ck

Description: Located approximately 150ft west of the detached structure @ (b) (6) [redacted] Well has piston style spigot within 5ft from it where samples were obtained
notes:
Owner Did come out & confirm that the well was for (b) (6) [redacted]
(b) (6) [redacted] also may require an ROE.
Sample Time 1051

Moses Lake 5/18/16
Private Wells/ EPA

Arrived at (b) (6) [redacted] 1135
WP-111

Begin Time	Purge Min	Temp °C
1138	0	17.2
1140	2	16.4
1142	4	16.2
1144	6	16.3

stable

purged 12.5 gallons

Sample time 1144
uplicate Sample time 1146

Moses Lake 5/18/16

Arrived at (b) (6) [redacted] 1155
WP-33

No one home door tag left at front door

Begin Time	purge Minute	Temp °C
1200	0	15.5
1202	2	16.0
1204	4	16.0
1206	6	15.8

stable

Purged 8 gallons

Sample Time 1207

Moses Lake 5/18/16
Private wells / EPA

Arrived at (b) (6) [redacted] 1236
WP-173

No one home left door tag on front door.

Will sample at spigot @ ~~front~~ back of house since well house is locked. The piston style spigot is painted (b) (6) [redacted] Located east of well house. Sampling was conducted through ~~s~~

Time	Minute	Temp °C
1252	0	15.2
1254	2	15.8
1256	4	15.8
1258	6	15.5
1300	8	15.4
1302	10	15.3

Stable

Purged 9 gallons

Sample time: 1304

Moses Lake 5/18/16
Private wells / EPA

(b) (6) [redacted]
WP-83
Totalizer Reading
1924404

Arrived at (b) (6) [redacted] 1334
WP-14
Began Purge

Time	Minute	Temp C°
1339	0	19.6
1341	2	19.6
1343	4	19.5
1345	6	19.5

Stable

Purge 5 gallons

Totalizer Reading:
1728251.1

Sample Time 1346

Moses Lake 5/18/16
Private Wells / EPA

Arrived at (b) (6)
WP-71B
Began Purge

Time	Minute	Temp °C
1428	0	17.3
1430	2	17.3
1432	4	17.3
1434	6	17.3

stable

Purged 5 gallons

Sample time 1435
using equipment

Moses Lake 5/18/16
Private wells / EPA

Arrived at (b) (6) 1610
WP-148

Began purge

Time	Minute	Temp °C
1613	0	16.2
1615	2	16.2
1617	4	16.2
1614	6	16.2

Purged 7 gallons

Sample Time 1620.

End of day.

Private Wells and Monitoring Wells Groundwater Sampling Field Report

August 2016 Field Sampling Event

Moses Lake Wellfield Superfund Site
Moses Lake, Washington

Field Investigation:
16-18 August 2016

Report Prepared:
August 2016

By: Technical Services Branch

US Army Corps of Engineers ®
Seattle District

Table of Contents

1.0 BACKGROUND AND OBJECTIVE OF INVESTIGATION

1.1 Background

The Site is located within and beyond the northwestern region of the City of Moses Lake, Washington. The Site encompasses approximately 15 square miles and includes the Grant County International Airport and surrounding area (formerly the Larson Air Force Base (LAFB)), commercial facilities, and residences.

Previous environmental investigations conducted at the Site identified contamination of soil and groundwater resulting from historic operation of the former LAFB and industrial activities associated with the aircraft industry. Potential source areas are scattered throughout the Site and approximately 1000 acres of groundwater have been identified as contaminated to date.

Previous investigations focused primarily on the former LAFB. The former LAFB occupied approximately 9607 acres and was active from 1942 until 1966. In 1988, three municipal wells operated by the City of Moses Lake were found to be contaminated with trichloroethene (TCE). Additionally, TCE was historically detected in two domestic wells operated by the Skyline Water System, Inc., a private water provider located in unincorporated Grant County south of the former LAFB property. Domestic (residential) and commercial (light or heavy industrial) private wells locations outside the former base have also had detections of TCE. TCE concentrations associated with the Site have been found to exceed EPA's National Primary Drinking Water Standards (the Maximum Contaminant Level (MCL)) under the Federal Safe Drinking Water Act. The MCL represents the maximum level (i.e., concentration) of the contaminant allowed in drinking water, and is set at 5 µg/L for TCE.

Based on the TCE detections described above, between 1989 and 1993 the City chose to fix the three contaminated City water-supply wells south of the Airport by extending the casings down to the lower basalt aquifers. In addition, the Skyline community, which was dependent on the Skyline water system, received an alternative water source (bottled water) between 1997 and 2003. In 2003, USACE completed construction of a replacement water-supply well, which draws water from a deeper, uncontaminated groundwater aquifer, and currently provides drinking water to the Skyline community.

Following findings of contaminated domestic (private) wells and upon request from Region 10 EPA, USACE began a private well groundwater sampling program in 2001. The groundwater sampling program has been used to ensure that humans are not exposed to contaminant concentrations above the MCL, and to monitor TCE plume migration.

In 2002, following two private well monitoring events, a whole house filter (WHF) system was designed and installed at five residential sites where it was determined that TCE contamination could potentially exceed the drinking water standard for TCE (5 µg/L).

Groundwater monitoring wells have been installed over the last 22 years in order to monitor contamination at the Site. Groundwater elevation data are collected where available to evaluate groundwater flow direction and are also used to evaluate plume migration at groundwater monitoring wells.

An IROD was signed in September 2008 (EPA 2008) for cleanup actions in areas with soil and groundwater contamination that exceed risk-based concentrations. The IROD required groundwater pump and treat systems to be installed for two of five identified TCE plumes. The IROD further specified that cleanup levels will be attained throughout all the plumes, but active remediation may be discontinued if it can be demonstrated that natural attenuation (through dilution) can remediate the remnant plumes in a reasonable timeframe (within the estimated 30 years for cleanup).

The IROD specifies that information gathered during groundwater monitoring, as well as design and operation of the selected groundwater pump and treat system, be used to determine the need for refinement of the selected groundwater remedy to meet groundwater restoration goals. The COCs monitored in the groundwater sampling program are as follows:

- trichloroethene (TCE)
- cis-1,2-dichloroethene (cis-DCE)
- trans-1,2-dichloroethene (trans-DCE)
- vinyl chloride (VC)
- 1,1-dichloroethene (1,1-DCE)
- 1,2-dichloroethane (DCA)
- 1,1,1-trichloroethane (TCA)
- 1,1-dichloroethane (1,1-DCA)

Only TCE, however, has a cleanup level established in the IROD, and the other VOCs have either never been detected or have been detected only at levels far below any established MCL or risk-based cleanup level.

1.2 Groundwater Sampling Event Summary and Objectives

In coordination with the US Environmental Protection Agency (USEPA) Region 10, one USACE environmental field team deployed to conduct the August 2016 Moses Lake Wellfield groundwater sampling event during a single mobilization. The events described in this report involve USACE field teams verifying sample point locations; discussion of sampling techniques; recording groundwater observations; collecting groundwater samples; and delivering those samples to the lab for analysis. Environmental sampling team members responsible for the August 2016 field event were Karah Haskins and Alex Meincke.

All of the work described in this report was accomplished in accordance with the Moses Lake Wellfield Superfund Site Quality Assurance Project Plan. In addition, the teams followed the guidance presented in: the Seattle District, USACE Safety and Health Plan; USACE Safety Manual EM 385-1-1; Seattle District, USACE, Sampling Standard Operating Procedures (SOP).

The private wells designated for sampling are displayed on a map found at Appendix A. These wells have been selected based on the approved 2016 Work Plan (USACE 2015)

One environmental field team deployed to the Site and collected groundwater samples from 15 private well systems, and deployed passive diffusion bags and collected depth to water at 24 monitoring wells:

Karah Haskins and Alex Meincke collected groundwater samples from 15 private well systems and deployed 24 passive diffusion bags in monitoring wells between 16 and 18 August 2016. Deployed passive diffusion bags will be sampled in November 2016.

The objectives of groundwater sampling at Moses Lake are to: 1) collect representative samples from designated private well systems and monitoring wells yielding data of known and sufficient quality to evaluate TCE concentrations and define existing TCE plumes; 2) to assure compliance with the requirements of USEPA; and 3) to make critical project - specific decisions based on the evaluated data.

2.0 DESCRIPTION OF WORK

2.1 Activities Prior to the August 2016 Groundwater Sampling Event

For all properties designated for sample collection, owners (and renters if applicable) were contacted to coordinate sample collection times during the scheduled field sampling week. Many of the owners allowed the sampling teams to work on their property while they were not at home.

For private well sampling, the field team was tasked with determining the most appropriate cold-water tap or other sample port as close to each wellhead as practical, while comparing notes on sample points collected during previous sampling events. The team was briefed that groundwater samples would not be collected from taps delivering chlorinated, aerated, softened or filtered water.

2.2 Private Well Sampling Procedures

During the August groundwater sampling event, samples were collected from a total of 13 private wells consisting of: 5 private well system hose bibs (WP-04, WP-27, WP-131, WP-167, and WP-168), and ten WHF systems (WP-14, WP-70, WP-83, WP-86, WP-119, WP-121, WP-123, WP-124, WP-125 and WP-129).

USACE has determined private well and WHF groundwater purging shall to consist of: allowing water flow at the sampling port at a rate of approximately 0.5 to 1 gallon per minute (gpm), while measuring the temperature of the water stream with a digital thermometer every two minutes until stabilization is achieved. These procedures follow the general principles of the New Hampshire private well system water sampling guidance.

While purging continued, the field team monitored the surrounding area and flowing water for unusual observations and odors as purge water was captured in a five gallon bucket. They recorded the start time of the purging in the field logbook immediately after opening each hose bib sample point and establishing the flow rate. While one team member used the digital thermometer to measure water temperatures, the other recorded the temperatures every two minutes until the parameters stabilized.

Upon reaching stabilization, the approximate total purged volume was recorded in the project field book along with any other significant observations. The team then conducted the sample collection activities.

Prior to collecting a water sample, the team reduced the flow rate at each tap to approximately 150 to 200 ml/min. to minimize sample water turbulence and aeration. Prior to sample collection at each private well system, the samplers donned clean Nitrile gloves to prevent exposure to contaminants and cross-contamination. All groundwater samples were collected in pre-cleaned certified containers obtained from the analytical laboratory.

All sample containers were filled with water directly from each tap – forming a meniscus at the top of each vial to provide zero headspace samples as required. Sample point location and components of each plumbing system were noted to assist in data interpretation. In addition, each team placed handle tags (indicating that water samples were taken by USACE on that date and time) on the front doors of homes sampled if nobody was home during sample collection.

After the sample containers are filled, sample labels describing project, location, analysis, team members, preservative, sampling date, and collection time are placed on the containers. The samples are then packaged in bubble wrap bags and plastic zipper type bags, placed into pre-iced sample shipping coolers and prepared for shipment as described in Section 3.0. All sampling teams worked to ensure each property was left just as they found it with no damage done, and any doors or gates closed as required.

2.3 Whole House Filter Sampling Procedures

In coordination with USEPA and affected Moses Lake area homeowners, granular activated carbon (GAC) water filters have been installed in private well systems showing TCE results of 3.5 µg/l or greater. Each GAC filter system consists of two lightweight composite GAC filter tanks (acting as lead and lag filters), associated piping, bag filters (to prevent GAC particles from entering the household plumbing system), pressure gauges and valved/regulated sample collection ports.

Groundwater samples were collected from ten WHF systems (WP-14, WP-70, WP-83, WP-86, WP-119, WP-121, WP-123, WP-124, WP-125 and WP-129) during the August 2016 sampling event. Each system was purged according to the revised private well sampling SOP consisting of allowing water flow at a hose bib nearest the wellhead at a rate of approximately 0.5 to 1 gpm, while measuring the temperature of the water stream with a digital thermometer every two minutes until stabilization is achieved. During purging, continuous temperature readings were recorded using a digital thermometer until water temperature stabilization was achieved. Once water temperature had stabilized, the hose bib was closed, and the field team prepared to collect samples from the pre-determined WHF sample ports (labeled “A” for the lead inlet port, “B” for the lead outlet port, and “C” for the lag outlet port).

WHF sample collection consists of opening each designated sample port valve fully to allow the maximum restricted flow rate of approximately 150 to 200 ml/min to flow into a capture bucket for a few seconds to ensure organic matter or air bubbles have been flushed out of the system. Restrictors have been placed on the sampling lines to provide a smooth, non-turbulent stream at a low-flow rate to minimize loss of volatiles that may be present in the water stream. Next, the sampling team immediately fills three pre-preserved VOA vials to zero headspace. New Nitrile gloves were donned before collecting samples at each port. All discharged water was directed into a five gallon plastic bucket for transfer to ground surface away from the shed or pump house GAC filter location after the samples were collected.

2.4 Monitoring Well PDB Deployment Procedures

The PDBs were purchased from ALS Environmental laboratory under license by the US Geological Survey and The General Electric Company, both co patent-holders. The 1 ¼" diameter low-density polyethylene PDBs were pre-filled with 220 ml or 330 ml of ASTM Type II certified, laboratory-grade, deionized water. Each filled PDB was then heat sealed by the laboratory prior to shipment to USACE via overnight delivery in hermetically sealed pouches.

The environmental field team deployed PDBs in preparation for the November 2016 sampling event. PDB deployment consisted of the following procedures:

1. The team verified each monitoring well location and identification number with project maps and the sample matrix. They verified work can proceed safely in the vicinity of moving vehicular traffic as required. The PDBs were prepared over clean sheets of aluminum foil prior to being placed into each well. The team used a pry bar, socket wrench or pinhead hex wrench as needed to open each flush mount monitoring well cover plate, and a Masterlock #485 padlock key for the standard "stick-up" well completions. The team donned new Nitrile gloves for groundwater sample collection.

2. The team collected depth to groundwater using a water level meter.

2. The team verified the number of PDBs, weights and anchor length required for each individual well. Where extra volume is required for November 2016 sampling, the team deployed 330ml PDBs.

3. The team ensured that all PDBs were lowered to the required depth and secured to the well cap.

4. Finally, the team securely capped and locked each monitoring well riser and cover plate when finished.

2.5 Sampling Event Activities and Observations

2.5.1 Private Well Sampling

USACE environmental field team consisted of Karah Haskins and Alex Meincke. The environmental field team collected samples at their own pre-assigned set of 10 whole house filter well system sample ports and five private well system hose bibs.

During the period of 16-18 August, 2016, the team collected groundwater samples from the following private well systems with whole house filters installed: WP-14, WP-70, WP-83, WP-86,

WP-119, WP-121, WP-123, WP-124, WP-125, and WP-129. During that same time period, the team collected groundwater samples from the following private well systems: WP-04, WP-27, WP-131, WP-168, and WP-169.

All required 40 ml VOA sample vials were obtained by the USACE contract lab ARI, and delivered to USACE pre-preserved with maleic and ascorbic acid.

Trip blanks were sent inside each sample shipping cooler delivered to the analytical lab.

Even though a right of entry permit has been signed, and verbal or written permission granted to collect samples at each designated location, the sampling team always attempted to contact the owner or resident at each private well location before beginning the field sampling activities. Upon arrival at each private well property designated for sample collection, the team verified they were at the correct address using maps, notes, and the sampling matrix, and verified through field documentation they were ready to collect samples at the correct sampling point (hose bib, or suitable water discharge port nearest to the wellhead.

Per modified SOP, sampling point valves were opened, and water allowed to flow at approximately 0.5 gpm into a capture bucket. Next, water temperature readings were measured every two minutes until stabilization was achieved. During the November sampling event, water temperature stabilization averaged approximately eight minutes elapsed purging time with most locations reaching stabilization within six minutes as shown in Table 1 below.

Table 1: Private Well Stabilized Water Temperatures and Purge Times

Well Location ID	Stable Temp. °C	Total Purge Time (Minutes)
WP-04	16.4	6
WP-14	19.8	6
WP-27	14.6	6
WP-70	19.6	6
WP-83	16.9	6
WP-86	16.6	6
WP-119	19.3	6
WP-121	23.1	6
WP-123	18.8	6
WP-124	18.6	6
WP-125	16.6	6
WP-129	Sprinkler was running. No purging occurred.	
WP-131	13.8	6
WP-167	15.0	6
WP-168	Sprinkler was running. No purging occurred.	

Upon achieving stabilization, the final stabilized readings were entered into the project field book. Prior to collecting a water sample, the flow rate at each tap was reduced to approximately 100 to 200 ml/min. to minimize sample aeration and turbulence. The sampling team donned new Nitrile gloves prior to sample collection at each residence. In the case of the

WHF sample ports, restrictors on the sample ports provided a stream of sample water at approximately 150 to 200 ml/min. All sample containers were filled with water directly from each tap – forming a meniscus at the top of each vial to provide zero headspace samples as required.

Significant Observations Made During Private Well/WHF Sampling

Due to the presence of containerized chemicals near the sample point, one field blank sample was collected at WP-83 using reagent-grade water.

Teflon sample tubing was attached to the hose bib at WP-167 to mitigate turbulent water flow. Water was allowed to run through tubing to flush out any contaminants prior to sampling. At WP-125 the flow restrictor was removed from the A port because water was not flowing at a rate acceptable for sampling. Also, at WP-125 rust colored water was observed from purge spigot after filters. This color dissipated almost immediately, but then returned after two minutes of purging. Again it was only for a few seconds and then water was clear again. All piping seemed to be intact. WHF system was installed in 2015 so system is relatively new.

All samples were hand delivered to ARI in Tukwila, WA on 18 August 2016.

2.5.2 Passive Diffusion Bag Deployment

The USACE environmental field team deployed new PDBs into a pre-assigned set of 24 PDB monitoring wells during the August 2016 mobilization in preparation for the November 2016 event.

The team generally worked from the north end of the Site and moved to the far south end. A total of 24 monitoring wells were fitted with new PDBs. The PDBs were installed in the following order: 14BW02; 14EX04; 14BW01; 14EX03; 12CW04; 12BW05; 04CW05; 12BW07; 12EX01; 02BW01; 04CW07; 12BW08; 12EX02; 04BW09; 14BW03; 14EX05; 12CW03; 12BW04; 12CW02; 12BW03; 12CW01; 12BW02; 12CW05; 12BW06.

The team first verified each monitoring well location and identification number with project maps and the sample matrix. The team also verified that work could proceed safely in the vicinity of moving vehicular traffic or other physical, biological, or environmental hazards that may have been present near each monitoring well.

Each team member donned new Nitrile gloves PDB deployment.

The sampling team recommends continued use of protective mesh PDB sleeves in wells with steel risers due to a greater potential for damage to the PDB membranes (monitoring wells 12EX01, 12EX02, 14EX03, 14EX04, and 14EX05).

Two sizes of PDBs were ordered: The bags consisted of the standard 220 ml size, and a larger 330 ml bag selected to accommodate primary and field duplicate samples where required. In some wells, two 330 ml PDBs were connected in tandem and lowered to the mid-screen depth to accommodate primary, field duplicate, and MS/MSD sample volumes as required. Two PDBs were installed at two mid-screen depths if a designated well had two screened intervals (as found in wells 04CW07, 12BW03, and 12BW04). All PDBs and stainless steel anchor weights were purchased from ALS Environmental, and shipped to the District office by UPS overnight delivery.

Following the established PDB deployment procedures, both environmental team members worked together using a table of Moses Lake monitoring well logs to determine the number of required weights, length of nylon suspension line, and number of PDBs required at each designated well. Wells deeper than 200 feet generally required two steel weights to allow proper PDB positioning. Each team member donned a new pair of Nitrile gloves prior to working on PDB assemblies at each well. Steel weights, suspension lines, and PDBs were quickly assembled on a strip of clean aluminum foil on the tailgate of the sampling vehicle. The prepared assembly of PDB, suspension lines, and weights was lowered into place at each well within 10 to 15 minutes to reduce the possibility of contaminants entering the diffusion bags during deployment.

At each specific well, the team lowered the weight into the well first, followed by the suspension line and PDB. The team worked to keep the assembly centered within the well casing as they slowly lower it to the well bottom. When the team felt the weight hit well bottom, they pulled up the line approximately one inch and tied it off securely to the casing plug or well cap. This method ensured the PDB would always be centered at the mid-well screen depth. Finally, the well cap was locked, or the cover plate secured with locking bolts depending on type of well encountered – stick up or flush mount.

All laboratory-filled PDBs arrived at the USACE office in good condition prior to field deployment. Each PDB was packed in groups of 10 into sealed foil pouches to prevent inadvertent contamination until deployment into the designated monitoring wells. No specific difficulties or problems were noted during PDB deployment.

Significant Observations Made During Passive Diffusion Bag Sampling

No mesh sleeve was used at 14EX05 because an insufficient number of sleeves were sent. The team took extra precaution when lowering PDB. The team mistakenly had a 10ft anchor line attached to 12CW03 so 24 hours after deploying the team raised the PDB 5ft and retied string.

Many small ants were observed at 04BW09.

3.0 INVESTIGATION DERIVED WASTE

No investigation-derived waste was generated during this sampling event. All residual PDB water or purged well water was transferred directly to ground surface on each property away from the sample collection point.

4.0 PACKAGING AND SHIPMENT

As mentioned in the narrative of each sampling event, groundwater samples were packaged in shipping coolers on ice and under chain of custody hand delivered directly to laboratory.

All sample shipping coolers were prepared for laboratory delivery in the following manner: Each cooler was lined (sides and bottom) with plastic “bubble-wrap” sheets for shock absorption. A large 30-gallon plastic garbage bag was then placed into the cooler to contain the sample water in the event of container breakage during shipment to the laboratories. The glass sample vials were labeled, placed into plastic zip-seal bags, and placed into foam shipping blocks or bubble-wrap bags for shock protection. All the samples were placed in the shipping coolers as indicated on the corresponding chain of custody forms. Gallon size plastic zipper bags of cubed ice bags were placed between and on top of the samples in each cooler to ensure maintenance of the required four degrees centigrade (plus/minus two degrees) sample preservation temperature. The completed chain of custody (COC) forms were placed in gallon size plastic zipper bags and taped to the inside of each cooler lid. Two custody seals were affixed to the outside of each cooler. The custody seals were placed so that the coolers could not be opened without breaking the seals. Each cooler was then securely sealed with fiber tape. The field team ensured drain plugs were securely taped inside and out to prevent possible water leakage.

The laboratory was informed of the sample delivery and ensured the samples were properly accepted and checked in upon receipt the following morning after the sample containers were shipped. All sample coolers and sample containers were accounted for at the contract laboratory following each shipment.

5.0 LABORATORY ANALYSIS

Chemical analyses performed on the samples were as follows: VOCs (Method 524.3).

6.0 DECONTAMINATION PROCEDURES

PDB weights, flow cells and associated tubing, water level indicator meters, and water volume measurement containers used by each team were decontaminated at the end of the project with an Alconox®-water solution followed by triple rinsing using distilled water in the USACE Geology Laboratory.

7.0 PROTECTION LEVEL

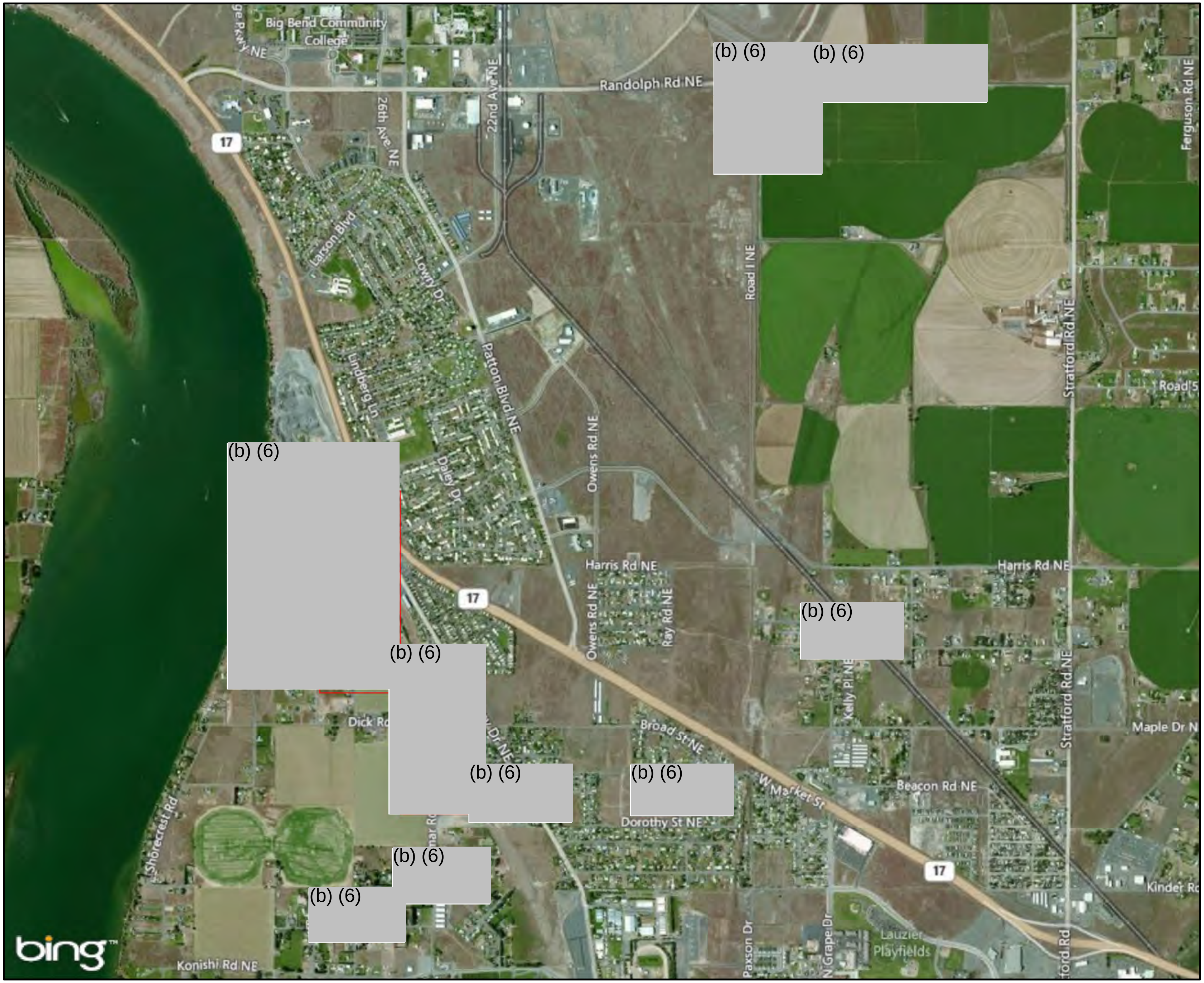
All sampling activities were conducted under Worker Protection Level D. For this project, personnel protective equipment included reflective safety vests, safety splash protection glasses, Nitrile gloves, and safety steel toe boots. New pairs of Nitrile gloves were donned prior to handling acid-preserved sample containers and between each unique private well sample point or monitoring well.

End of Field Sampling Report

Appendix A

Site and Well Location Maps

2016 MOSES LAKE SAMPLING MAPBOOK



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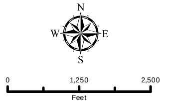
Location Map



App A - August 2016 Event

2016 MOSES LAKE SAMPLING MAPBOOK (A7 - PAGE 1 OF 23)

(b) (6)

Legend

- Well Location (1)
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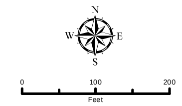
Location Map

(b) (6)



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2016 MOSES LAKE SAMPLING MAPBOOK (A8 - PAGE 2 OF 23)

(b) (6)

Legend

- Well Location (2)
- Uncertain Location (0)

Location Map

(b) (6)

N W E S

0 100 200
Feet

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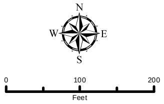
2016 MOSES LAKE SAMPLING MAPBOOK (K1 - PAGE 5 OF 23)

Legend

- Well Location (6)
- Uncertain Location (0)

Location Map



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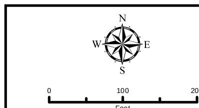
2016 MOSES LAKE SAMPLING MAPBOOK (L1 - PAGE 6 OF 23)

Legend

- Well Location (15)
- Uncertain Location (0)

Location Map



App A - August 2016 Event

2016 MOSES LAKE SAMPLING MAPBOOK (L2 - PAGE 7 OF 23)

Legend

- Well Location (7)
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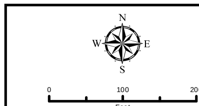
Location Map



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Y:\Larson Groundwater Sampling and WHF\GIS\Maps\2014 June Private Well Sampling Mapbook.mxd

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2016 MOSES LAKE SAMPLING MAPBOOK (M1 - PAGE 8 OF 23)

Legend

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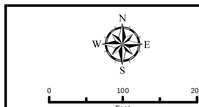
Location Map



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App A - August 2016 Event

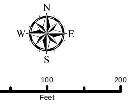
2016 MOSES LAKE SAMPLING MAPBOOK (P2 - PAGE 15 OF 23)

(b) (6)

Legend

- Well Location (5)
- Uncertain Location (3)

Location Map



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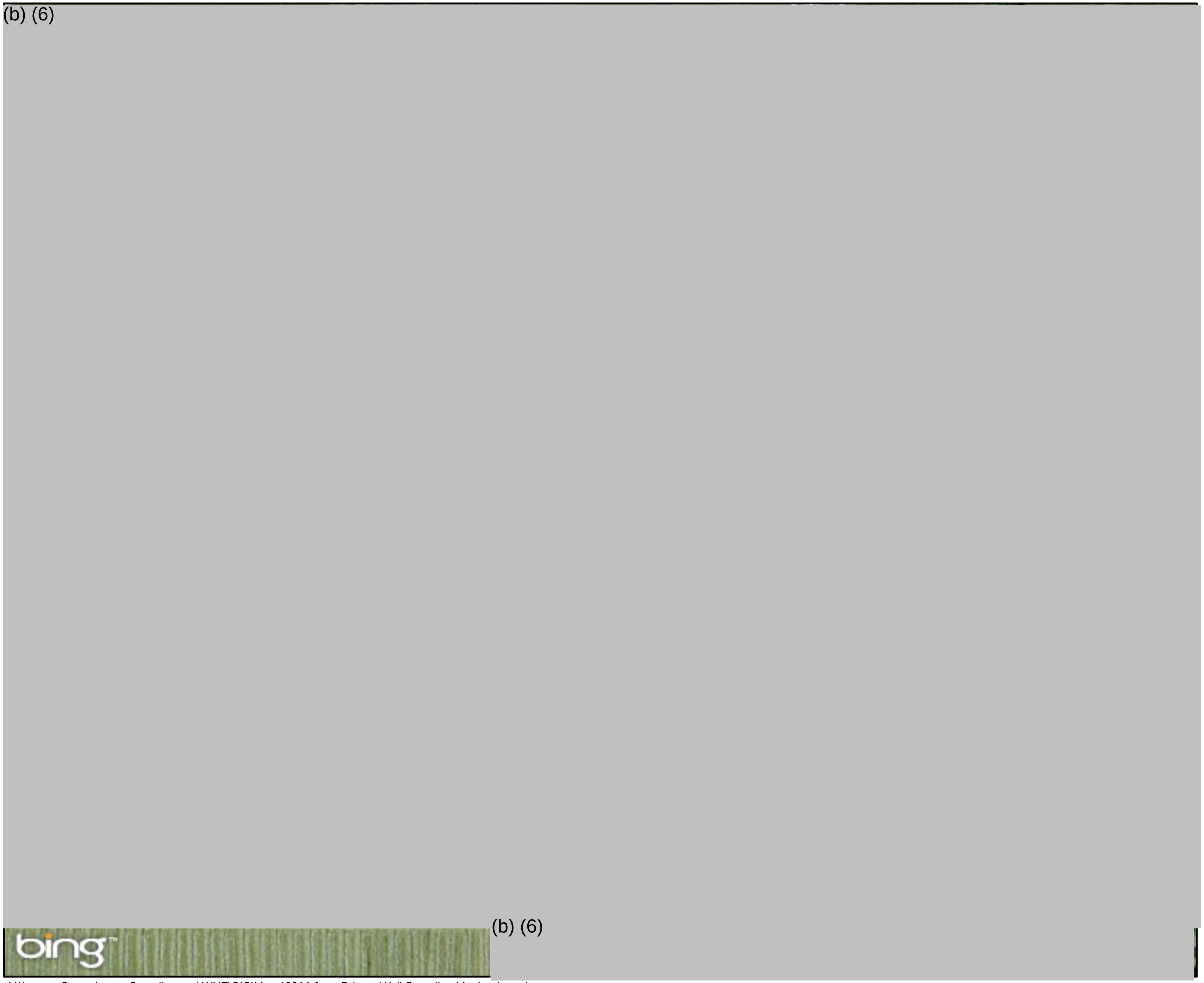
2016 MOSES LAKE SAMPLING MAPBOOK (Q3 - PAGE 17 OF 23)

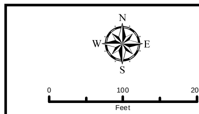


Legend

Well Location (7)

Uncertain Location (0)

Location Map

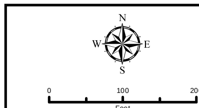


2016 MOSES LAKE SAMPLING MAPBOOK (S6 - PAGE 21 OF 23)

Legend

- Well Location (1)
- Uncertain Location (0)

Location Map



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2016 MOSES LAKE SAMPLING MAPBOOK (E2)

Legend

Well Locations (18)

Location Map

N
W E
S

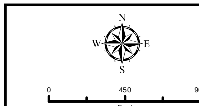
0 450 900
Feet

2016 MOSES LAKE SAMPLING MAPBOOK (F2)

Legend

Well Locations (31)

Location Map

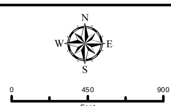


2016 MOSES LAKE SAMPLING MAPBOOK (G2)

Legend

Well Locations (25)

Location Map

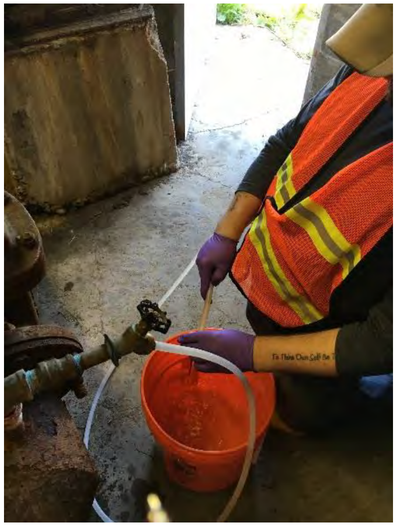


Y:\Larson Groundwater Sampling and WHF\GIS\Maps\2014 May Sampling Mapbook.mxd

5/9/2014 9:05:04 AM

APPENDIX B

Field Sampling Photos



160816-WP27-1

160817-WP14-1

160817-Installing PDBs

160817-WP70-1

160817-WP70-2

160817-WP83-1

160817-WP83-2

160817-WP83-3

160817-WP83-4

160817-WP86-1

160817-WP83-5

160817-WP119-1

160817-WP121-1

160817-WP123-1

160817-WP121-2

160817-WP125-1

160817-WP125-2

160817-WP125-4

160817-WP125-3

160817-WP129-1

Appendix C

Field Notes

Location Moses Lake Date 8/16

Project / Client August Sampling Event

14BW02 (1)

WL: 106.50'

14EX04 (1)
WL: 106.70'

14BW01 (2) 330

WL: 93.31'

14EX03 (1)
WL: 93.76'

12CW04 (1)
WL: 103.30

12BW05 (1)
WL: 87.45

Location Moses Lake Date 8/16

Project / Client

04CW05 (1)

WL: 100.84

*who mows grass around wells? should request that they do south of Loring

12DW07 (1)
WL: 86.78

12EX01
WL: 86.70

WP-27

Time	0	2	4	6
Temp	15.3	15.4	15.4	15.4

xSample Time: 1406

Location Moses Lake Date 8/16

Project / Client August Sampling / PDB

02BW01 (1)
WL: 137.51'

04CW07 Dual

WL: 160.88

12BW08 (1)
WL: 120.78

12EX02 (1)

WL: 120.99 End 8/16

8/17

04BW09 (1)

WL: 82.45'
weird small ants everywhere

14BW03 (1)
WL: 84.91'

14EX05 (1) No sleeve. was careful
WL: 84.77' lowering

Location Moses Lake Date

Project / Client August Sampling / PDB

12CW03 (1)
WL: 109.68

12BW04 Dual

WL: 97.87

WP-04

Time	0	2	4	6
Temp	16.4	16.4	16.4	16.4

purged about 5 gal

*Sample Time 0925

Well water only used
spraying gravel & filling trucks
[redacted] (b) (6)

WP-121 owner not home
Sam
78 | 101.0

Time	0	2	4	6
Temp	23.1	23.1	23.1	23.1

purged 15 gal

Sample Time A: 1015

Location Moses Lake Date 8/17

Project / Client August Sampling / PDB

WP-119

Time	0	2	4	6
Temp	19.3	19.4	19.3	19.3

purged: 10 gal
totalizer: 204950.8
* Sample Time A: 1040

WP-123

Time	0	2	4	6
Temp	18.8	18.8	18.9	18.8

purged: 10 gal
totalizer: 278623.3
* SAMPLE: 1103

WP-125 *broke flow controller
Rust colored water originally coming out of purge spigot in well house. disappears after 2-3 seconds. after 30 seconds more rust color came through tube

Time	0	2	4	6
Temp	16.6	16.6		

totalizer: 562451.2 *Sample time: ~~[illegible]~~ 1125

Location Moses Lake Date 8/17

Project / Client August Sampling / PDB

WP-124

Time	0	2	4	6
Temp	17.7	18.6	18.5	18.6

purged 5 gal
totalizer 292767.4
* Sample time 1155

WP-8~~3~~6
No purge because sprinkler was running & connected to normal purge spigot.

Totalizer 0654354.5
*Sample Time 1305

WP-131
Purged 15 gal first

Time	0	2	4	6
Temp	16.6	16.7	16.6	16.6

Then purged 5 gal
SAMPLE: 1334

Location: Moses lake Date: 8/17
Project / Client: August sampling & PDB

WP-70 (MS/MSD)

Time	0	2	4	6
Temp	19.6	19.6	19.6	19.6

purged: 5gal
Totalizer: 250430.1
*Normal: 1355
*FD: 1400

WP-~~131~~-129

water was running no purge

Sample Time: 1424
Totalizer: 162732.5

WP-167

Time	0	2	4	6
Temp	15.0	15.1	15.0	15.0

purged 10 gal
*sample: 1448

Location: Moses lake Date: 8/17
Project / Client: August Sampling & PDB

WP-168
No purge sprinkler was running. Sample was taken from teflon tubing

Sample time 1500

WP-83

Time	0	2	4	6
Temp	16.9	16.9	17.0	16.9

purged 10gal
*sample 1548
Field blank because lawn mower
*1608 ~~FB83~~ FBWP83: 1535

WP-14 SPRINKLERS WERE RUNNING

Time	0	2	4	6
Temp	16.4	16.4	16.4	16.4

purged 15 gal
Duplicate 1610
Normal 1605
Totalizer 1989092.7

- END DAY 2 -

Location: Moses lake Date: 8/18

Project / Client: August Sampling & PDB Deploy

12CW02 (1)
WL: 168.75'

12BW03 (2) Dual
WL: 128.38

* 12CW03 → need to raise 5 feet because we used wrong anchor line

12CW01 (1)
WL: 150.73

12BW02 (1)
WL: 118.69

12CW05 (1)

WL: 155.81'

12BW06 installed 2332
forgot to at 12BW07

WL: 117.97

Location:
Date:
Project / Client:

School

* gate enterance is about 12 ft wide & on other side of field.

* fence is about 4ft high

* road is ~30ft wide

* crosswalk near area proposed. would most likely not be able to use during drilling

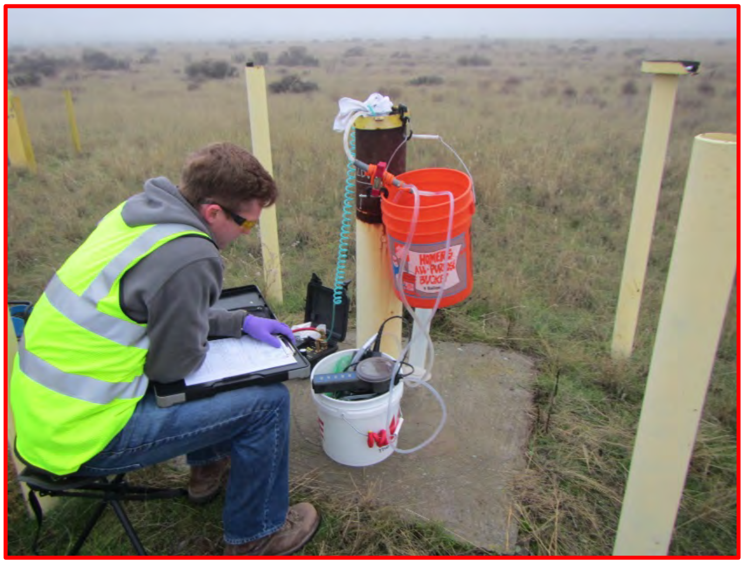
* curb is ~6" tall

* October they blow out sprinklers

Private Wells and Monitoring Wells Groundwater Sampling Field Report

November 2016 Field Sampling Event

Moses Lake Wellfield Superfund Site
Moses Lake, Washington



Field Investigation:
14-16 November 2016

Report Prepared:
December 2016

By: Technical Services Branch

US Army Corps
of Engineers ®
Seattle District

TABLE OF CONTENTS

APPENDICES

1.0 BACKGROUND AND OBJECTIVE OF INVESTIGATION

1.1 Background

The Moses Lake Wellfield Superfund Site is located between the Grant County Airport and the City of Moses Lake, Washington. The Site includes the former Larson Air Force Base (LAFB) property, Port of Moses Lake property and adjacent private properties affected by Site groundwater contamination. The Site is listed on the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980 National Priorities List (NPL) for Uncontrolled Hazardous Waste Sites.

The Moses Lake Wellfield Superfund Site is an area of approximately 15 square miles, which includes the former LAFB, commercial facilities, and residences. The former LAFB occupied approximately 9,607 acres three miles northwest of the City of Moses Lake. The United States Air Force was active at the site from 1942 until 1966. During 1988 and 1989, the Washington State Department of Health confirmed the presence of trichloroethylene (TCE) above the Federal Maximum Contaminant Level (MCL) in three City of Moses Lake municipal wells and two Skyline community wells. The Seattle District, US Army Corps of Engineers (USACE) completed a Remedial Investigation (RI) phase in 2003. Appendix A of this report shows the general location map and a site map.

During the course of the RI, several private wells were tested and found to be contaminated with TCE. In 2001, the USACE contracted installation of carbon filtration units – known as whole house filter systems (WHF) - at five of those wells. Several years of groundwater monitoring data has been evaluated since the original WHF systems were installed.

The final results of the Phase I RI released in a report in March 1993 indicated that TCE was consistently found in shallow alluvial and upper basalt (*a*-basalt) groundwater in the central area of the former base.

On October 14, 1992, the affected areas of the former LAFB and off-site down gradient areas, termed the "Moses Lake Wellfield Contamination”, were listed on the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) of 1980 for Uncontrolled Hazardous Waste Sites. The former LAFB property is one part of the Moses Lake Wellfield Superfund Site; the site also includes the contaminant plume.

Chemical results from 1993 and 1994 combined with historical data indicated that TCE occurred in the central and southern portion of the former LAFB in alluvial and *a*-basalt groundwater. In 2004, USACE confirmed TCE contamination in the next lower basalt aquifer (c-basalt). As of 1995, the data suggest that more than one source may have contributed TCE to the alluvial and *a*-basalt groundwater in the central portion of the former LAFB.

In 1998, URS Greiner completed a sampling round of private water wells and wells for Class A and Class B water systems east, south and southwest of the previously known TCE plume. There were eight detections of TCE during this study. Four wells that were previously outside the plume extent were found to be above the detection limit.

1.2 GROUNDWATER SAMPLING EVENT SUMMARY AND OBJECTIVES

In coordination with the US Environmental Protection Agency (USEPA) Region 10, two USACE environmental field teams deployed to conduct the November 2016 Moses Lake Wellfield groundwater sampling event during a single mobilization. The events described in this report involve USACE field teams verifying sample point locations; discussion of sampling techniques; recording groundwater observations; collection of groundwater samples; and shipment of those samples by overnight delivery for laboratory analysis. Environmental sampling team members responsible for the November 2016 field event were Joseph Marsh, Jeff Weiss, Jacob Williams and Peter Gibson.

All of the work described in this report was accomplished in accordance with the Moses Lake Wellfield Superfund Site Quality Assurance Project Plan (QAPP). In addition, the teams followed the guidance presented in: the Seattle District, USACE Safety and Health Plan; USACE Safety Manual EM 385-1-1; Seattle District, USACE, Sampling Standard Operating Procedures (SOP).

The private wells and monitoring wells designated for sampling are displayed on a map found at Appendix A. These wells have been selected based on their down-gradient locations relative to the inferred flow direction of TCE-contaminated groundwater and validated sampling analytical data from previous monitoring events.

The two environmental field teams deployed to the Site and collected groundwater samples from a total of 15 private well systems, and 32 monitoring wells during the November 2016 sampling event as summarized below:

Team 1: Joseph Marsh and Jeff Weiss collected groundwater samples from 8 monitoring wells fitted with dedicated bladder pumps, and 24 monitoring wells fitted with laboratory-prepared passive diffusion bag samplers. Team 1 also deployed new passive diffusion bag samplers into 42 monitoring wells scheduled for sampling during the January, 2017 sampling event. Team 1 also collected static water level data from all sampled monitoring wells. These activities were conducted from 14-17 November, 2016.

Team 2: Jacob Williams and Peter Gibson collected groundwater samples from 10 private whole-house filter systems, and 5 private well systems. These activities were conducted from 15 through 16 November, 2016.

The objectives of groundwater sampling at Moses Lake are to: 1) collect representative samples from designated private well systems and monitoring wells yielding data of known and sufficient quality to evaluate TCE concentrations and define existing TCE plumes; 2) to assure compliance with the requirements of USEPA; and 3) to make critical project - specific decisions based on the evaluated data.

2.0 DESCRIPTION OF WORK

2.1 ACTIVITIES PRIOR TO THE NOVEMBER 2016 GROUNDWATER SAMPLING EVENT

The USACE project team worked to collect signatures on Department of the Army Right of Entry forms as required before conducting the well sampling on private, city or county government property. For most properties, previously signed Right of Entry forms were still valid. For all properties designated for sample collection, owners (and renters if applicable) were contacted to coordinate sample collection times during the scheduled field sampling week.

Prior to conducting sampling activities at each location, both teams verified the address or well location and map location matched, and that the Right of Entry form had been signed prior to arriving at each sampling location.

Each team was responsible for identifying potential health and safety hazards at each sampling location. If a hazard is verified at a private well sampling location, an alternate hose bib connected to the same water source may be selected in a safer area of the subject property. In the case of hazardous monitoring well conditions, the well may be situated in an active construction zone requiring the cancellation of sampling at that well until the next scheduled sampling event.

Also for private well sampling, the field team was tasked with determining the most appropriate cold-water tap or other sample port as close to each wellhead as practical. At each location, the team worked to collect water samples from the same sample point selected during previous sampling events to ensure consistent results. The team was briefed that groundwater samples would not be collected from taps delivering chlorinated, aerated, softened or filtered water.

2.2 PRIVATE WELL SAMPLING PROCEDURES

During the November 2016 groundwater sampling event, samples were collected from a total of 15 private wells consisting of: 5 private well system hose bibs (WP-4, WP-27, WP-131, WP-167, WP-168, and 10 WHF systems (WP-14, WP-70, WP-83, WP-86, WP-119, WP-121, WP-123, WP-124, WP-125, and WP-129).

USACE (in cooperation with USEPA) has determined private well and WHF groundwater purging shall to consist of: allowing water flow at the sampling port at a rate of approximately 0.5 to 1 gallon per minute (gpm), while measuring the temperature of the water stream with a digital thermometer every two minutes until stabilization is achieved. These procedures follow the general principles of the New Hampshire private well system water sampling guidance.

During purging, the flow rate at each location was verified by graduated cylinder. While purging continued, the field team monitored the surrounding area and flowing water for unusual observations and odors as purge water was captured in a five gallon bucket. They recorded the start time of the purging in the field logbook immediately after opening each hose bib sample point and establishing the flow rate. While one team member used the digital thermometer to measure water temperatures, the other recorded the temperatures every two minutes until the parameters stabilized.

Upon reaching stabilization, the approximate total purged volume was recorded in the project field book along with any other significant observations. The team then conducted the sample collection activities.

Prior to collecting a water sample, the team reduced the flow rate at each tap to approximately 150 to 200 ml/min. to minimize sample water turbulence and aeration. The samplers donned protective eyewear and new, clean, Nitrile gloves to prevent exposure to contaminants and cross-contamination. All groundwater samples were collected in pre-cleaned certified containers obtained from the analytical laboratory.

All sample containers were filled with water directly from each tap – forming a meniscus at the top of each vial to provide zero headspace samples as required. Sample point location and components of each plumbing system were noted to assist in data interpretation. A photographic record of each sample point was made by the team. In addition, each team placed handle tags (indicating that water samples were taken by USACE on that date and time) on the front doors of homes sampled if nobody was home during sample collection. A photo was taken of the handle tag and front of house in that case for the project files.

After the sample containers have been filled, sample labels describing project, location, analysis, team members, preservative, sampling date, and collection time are placed on the containers. The samples are then packaged in bubble wrap bags and plastic zipper type bags, placed into pre-iced sample shipping coolers and prepared for shipment as described in Section 3.0. All sampling teams worked to ensure each property was left just as they found it with no damage done, and any doors or gates closed as required.

2.3 Whole House Filter Sampling Procedures

In coordination with USEPA and affected Moses Lake area homeowners, granular activated carbon (GAC) water filters have been installed in private well systems showing TCE results of 3.5 µg/l or greater. Each GAC filter system consists of two lightweight composite GAC filter tanks (acting as lead and lag filters), associated piping, bag filters (to prevent GAC particles from entering the household plumbing system), pressure gauges and valved/regulated sample collection ports.

As described previously, groundwater samples were collected from 10 WHF systems during this November 2016 sampling event. Each system was purged according to the revised private well sampling SOP consisting of allowing water flow at a hose bib nearest the wellhead at a rate of approximately 0.5 to 1 gpm, while measuring the temperature of the water stream with a digital thermometer every two minutes until stabilization is achieved. Purge flow rates averaged approximately 0.5 gpm as measured with graduated cylinder, and purged water at each location was captured in a five gallon bucket to verify purged volumes. During purging, continuous temperature readings were recorded using a digital thermometer until water temperature stabilization was achieved. Once water temperature had stabilized, the hose bib was closed, and the field team prepared to collect samples from the pre-determined WHF sample ports (labeled "A" for the lead inlet port, "B" for the lead outlet port, and "C" for the lag outlet port).

WHF sample collection consists of opening each designated sample port valve fully to allow the maximum restricted flow rate of approximately 150 to 200 ml/min to flow into a capture bucket for a few seconds to ensure organic matter or air bubbles have been flushed out of the system. Restrictors have been placed on the sampling lines to provide a smooth, non-turbulent stream at a low-flow rate to minimize loss of volatiles that may be present in the water stream. Next, the sampling team immediately fills three pre-preserved VOA vials to zero headspace. New Nitrile gloves were donned before collecting samples at each port. All discharged water was directed into a five gallon plastic bucket for transfer to ground surface away from the shed or pump house GAC filter location after the samples were collected.

After filling the sample containers, sample labels describing project, location, analysis, team members, preservative, sampling date, and collection time were placed on each container and the container was placed in a plastic zipper bag. The bagged sample vials were placed into bubble wrap bags. Finally, the filled sample containers were placed into pre-iced shipping coolers to begin sample cooling to the required 4° Celsius sample preservation temperature prior to shipment to the analytical laboratory. One set of trip blanks were required and included per sample shipping cooler.

2.4 Monitoring Well Sampling Procedures

2.4.1 Monitoring Well Sampling Using Dedicated Bladder Pumps

Moses Lake monitoring well groundwater purging and sampling was performed in accordance with the Seattle District's Low-Flow Ground Water Purging and Sampling SOP, prepared in March 1999 and revised on 1 Sep 2009. Data generated during purging were recorded on the MicroPurge/Low-Flow Sampling Log forms (Appendix C).

The team verified each monitoring well location and identification number with project maps and tables. They verified work can proceed safely in the vicinity of moving vehicular traffic, heavy industry, and other hazards as required. The team used a pry bar, socket wrench or pinhead hex wrench as needed to open each flush mount monitoring well cover plate, and a Masterlock #485 padlock key for the standard "stick-up" well completions. Prior to purging each well, the depth to static water level in each well was measured and checked periodically to monitor draw down as a guide to flow rate adjustment (no greater than 0.4 foot drawdown is permitted to prevent sampling stagnant casing water).

Purging operations at each well commenced once the following equipment was prepared: the MP20 MicroPurge® Controller equipped with an adjustable pressure regulator was connected to the Well Wizard® bladder pumps via airline and quick connect fittings. Another airline was quick-connected to a pressurized CO_2 cylinder to drive the pump. Pump flow rates were then adjusted during a "pre-purge" period to maximize withdrawal rates and minimize excessive drawdown in each well. The evacuated pre-purge volume at each well was intended to flush out a bladder pump and tubing volume prior to monitoring stabilization parameters. Finally, a QED MicroPurge® basics MP20 Flow Cell was connected to the pump's discharge line at ground surface to measure established stabilization parameters (pH, specific conductivity, temperature, DO, ORP, and turbidity).

Depth to water measurements during purging were monitored and recorded to verify that minimal drawdown occurred. A graduated measuring cup was used to determine the volume purged. Generally, acceptable low-flow rates are no greater than 500 milliliters per minute (ml/min.), and are typically closer to 400 ml/min. for the Well Wizard® bladder pump systems, depending upon the amount of water level drawdown detected during pumping at each well. Purge data was recorded on the micro-purge logs every two minutes.

Low-flow purging continued until three consecutive measurements of the stabilization parameters met stabilization requirements.

Stabilization parameter requirements for all private well and bladder pump monitoring wells are as follows:

Temperature	+/- 0.2 ºC
Specific Conductivity	+/- 0.020 millisiemens/centimeter (mS/cm)
DO	+/- 0.2 milligrams/liter (mg/l)
pH	+/- 0.2 units
ORP	+/- 20 millivolts (mV)

At each monitoring well, groundwater sample collection would begin immediately after achieving stabilization of water quality parameters during low flow purging.

Prior to sample collection, the samplers donned protective eyewear and new, clean, Nitrile gloves to prevent exposure to contaminants and cross-contamination. All groundwater samples were collected in pre-cleaned, certified containers obtained from the analytical laboratory.

All sample containers were filled immediately following purging by disconnecting the flow-through cell from the pump tubing system, and capturing water directly from the discharge end of the tubing. All sample containers were carefully filled at a low-flow rate to minimize agitation. During sample collection, significant physical observations were recorded in the Micropurge/Low-Flow Sampling Log data forms and project field book as needed.

After filling the sample containers, sample labels describing project, location, analysis, team members, preservative, sampling date, and collection time were placed on each container and the container was placed in a plastic zipper bag. The bagged sample vials were placed into bubble wrap bags. Finally, the filled sample containers were placed into pre-iced shipping coolers to begin sample cooling to the required 4° Celsius sample preservation temperature prior to shipment to the analytical laboratory. One set of trip blanks were required and included per sample shipping cooler.

At the conclusion of groundwater sampling at each well, the flush mount well covers were bolted closed and stick up well caps padlocked.

2.4.2 Monitoring Well Sampling Using Passive Diffusion Bags

Passive diffusion bags (PDBs) were been selected by the Moses lake Project Delivery Team as the most appropriate, cost-effective method for groundwater sample collection from Moses Lake monitoring wells lacking dedicated bladder pumps. The PDBs were purchased from ALS Environmental laboratory under license by the US Geological Survey and The General Electric Company, both co patent-holders. The 1 ¼" diameter low-density polyethylene PDBs were pre-filled with 220 ml or 330 ml of ASTM Type II certified, laboratory-grade, deionized water. Each filled PDB was then heat sealed by the laboratory prior to shipment to USACE via overnight delivery in hermetically sealed pouches.

USACE ensures a minimum of 14 days of PDB equilibration time before returning to the Moses Lake site for groundwater sample collection per established PDB guidance. During this event, both sampling teams worked to collect the PDB samples as described in Section 2.5.3. PDB retrieval and sampling consisted of the following procedures:

1. The team verified each monitoring well location and identification number with project maps and the sample matrix. They verified work can proceed safely in the vicinity of moving vehicular traffic as required. The PDBs were prepared over clean sheets of aluminum foil prior to being placed into each well. The team used a pry bar, socket wrench or pinhead hex wrench as needed to open each flush mount monitoring well cover plate, and a Masterlock #485 padlock key for the standard “stick-up” monitoring well completions. The team donned new Nitrile gloves for groundwater sample collection.

2. The team carefully hauled each weighted PDB to the surface using the nylon suspension line. The sampling team carefully cut the top corner off each PDB and filled each sample vial. The team filled each vial just to overflowing and maintained a reverse meniscus. There was no down time once the PDB has been brought to the surface until sample collection was complete at each well. Any residual sample water in the used PDBs was discharged to ground surface.

3. Each PDB represented a unique sample ID number based on the well ID (and sample interval if two PDBs are deployed into one well). With the exception of the MS/MSD, all QC samples were submitted “blind” to the laboratory using a separate unique sample ID number not

labeled as duplicate or trip blank per USACE standard sampling procedure. One set of trip blanks were required and included per sample shipping cooler. An extra laboratory-prepared PDB was shipped to the site and was used for collection of the trip and field blanks at the direction of the USACE project chemist.

4. Once recovered and sampled, the empty PDBs and suspension lines were discarded as non-hazardous municipal waste. In addition, gloves, paper towels, bags, and other solid waste materials were disposed of as municipal waste. The PDBs and other solid waste material were placed into a large plastic garbage bag and tied securely prior to disposal. The stainless steel weights were decontaminated and returned to the Seattle District, USACE office.

5. Finally, the team securely capped and locked each monitoring well riser and cover plate when finished.

2.5 Sampling Event Activities and Observations

2.5.1 Team 1 Monitoring Well Bladder Pump Sampling

Groundwater sample collection commenced immediately after achieving stabilization of water quality parameters during low flow purging at each well using dedicated bladder pump systems as described previously. Following their standard field protocols, Team 1 worked from the far north end of the Site, moving to the far south end sampling each designated well as it was encountered. The project well maps and sample matrix were used to ensure samples were collected at the correct locations. The team used one 15 lb. compressed CO_2 cylinder acquired from Oxarc in Moses Lake to drive the pump systems, airlines, pump controllers, and flow cells to conduct the sampling of dedicated bladder pumps.

During this sampling event, Team 1 collected groundwater samples from a pre-determined set of 8 monitoring wells fitted with dedicated bladder pumps: 99AW01, 92BW01, 00AW11, 92BW02, 91BW04, 99BW18, 99AW09, and 99BW10.

Even though a right of entry permit has been signed, and verbal or written permission granted to collect samples at each designated monitoring well, the sampling team always attempted to contact the property owner for each monitoring well location before beginning the field sampling activities.

Team 1 worked to measure static water levels in all sampled monitoring wells (bladder pump and PDB wells).

Other than property owner notifications, no special access procedures were required for any of the other bladder pump monitoring wells sampled during this event.

Prior to sample collection, the samplers donned protective eyewear and new, clean, Nitrile gloves to prevent exposure to contaminants and cross-contamination. All sample containers were filled immediately following low-flow purging by disconnecting the flow-through cell from the pump tubing system, and capturing pumped groundwater directly from the discharge end of the pump tubing. During sample collection, physical observations were recorded in the Micro-purge/Low-Flow Sampling Log data forms.

Stabilization of water quality parameters during purging occurred within 6-10 minutes during this event. Measured temperatures ranged from 13.29° C at well 91BW04 to 14.90° C at well 99AW09. Specific conductivity ranged from 0.35mS/cm (well 99BW10) to 0.61 mS/cm (well 00AW11). Dissolved oxygen measurements varied widely from 9.80 ppm (well 00AW11) to 23.10 ppm (well 99BW10). PH values ranged from 6.87 units (well 99BW10) to 7.64 units (well 91BW04). Oxygen reduction potential ranged from 116 mV (well 99AW01) to 235 mV (well 99BW10).

Significant Observations Made During Team 1 Bladder Pump Sampling

Team 1 had to clear yellow jackets out of the well 92BW02 casing before being able to safely purge and sample the well. No other significant observations were made during this event.

2.5.2 Team 2 Private Well and WHF System Sampling

While environmental field team 1 worked independently on their set of wells, Team 2 collected samples at their own pre-assigned set of 10 whole house filter well system sample ports, and 5 private well system hose bibs.

During the period of 15-16 November 2016, Team 2 collected groundwater samples from the following 10 private well systems with whole house filters installed: WP-14, WP-70, WP-83, WP-86, WP-119, WP-121, WP-123, WP-124, WP-125, and WP-129. During that same time, they collected groundwater samples from the following 5 private well systems: WP-04, WP-27, WP-131, WP-167, and WP-168.

All required 40 ml VOA sample vials were obtained from Vendor ESS by the USACE contract lab ARI, and delivered to USACE pre-preserved with maleic and ascorbic acid.

Trip blanks were sent inside each sample shipping cooler delivered to the analytical lab.

Upon arrival at each private well property designated for sample collection, the team verified they were at the correct address using maps, notes, and the sampling matrix, and verified through field documentation they were ready to collect samples at the correct sampling point (hose bib, or suitable water discharge port nearest to the wellhead. The team always attempted to contact the owner or resident at each private well location before beginning the field sampling activities.

Per modified SOP, sampling point valves were opened, and water allowed to flow at approximately 0.5 to 1 gpm into a capture bucket. Next, water temperature readings were measured every two minutes until stabilization was achieved. During the November sampling event, water temperature stabilization ranged from 6 to 14 minutes elapsed purging time with most locations reaching stabilization within six minutes as shown in Table 1 below.

TABLE 1: PRIVATE WELL STABILIZED WATER TEMPERATURES AND PURGE TIMES

Well Location ID	Stable Temp. °C	Total Purge Time (Minutes)
WP-04	15.9	6
WP-14	19.8	10
WP-27	15.0	6
WP-70	15.4	8
WP-83	13.5	6
WP-86	13.2	8
WP-119	13.3	6
WP-121	13.4	8
WP-123	12.4	10
WP-124	14.7	6
WP-125	14.0	6
WP-129	17.7	12
WP-131	14.5	14
WP-167	15.0	6
WP-168	14.7	6

Upon achieving stabilization, the final stabilized readings were entered into the project field book. Prior to collecting a water sample, the flow rate at each tap was reduced to approximately 100 to 200 ml/min. to minimize sample aeration and turbulence. The sampling team donned new Nitrile gloves prior to sample collection at each residence. In the case of the WHF sample ports, restrictors on the sample ports provided a stream of sample water at approximately 150 to 200 ml/min. All sample containers were be filled with water directly from each tap – forming a meniscus at the top of each vial to provide zero headspace samples as required. A photographic record of each sample point was made by the team.

Significant observations made during Private Well/WHF Sampling

WP-04 – a large pile of gravel has been placed in front of the well house door, requiring the team to climb over the material to gain access to the wellhead. No other significant observations were made during this event.

2.5.3 Passive Diffusion Bag Sampling and Deployment

In addition to collecting bladder pump-derived groundwater samples, Team 1 also collected all designated PDB samples during the November 2016 event.

The 24 selected PDB wells were: 02BW01; 04BW09; 04CW05; 04CW07; 12BW02; 12BW03; 12BW04; 12BW05; 12BW06; 12BW07; 12BW08; 12CW01; 12CW02; 12CW03; 12CW04; 12CW05; 12EX01; 12EX02; 14BW01, 14BW02, 14BW03, 14EX03, 14EX04, and 14EX05.

All required 40 ml amber glass VOA sample vials were obtained from Vendor ESS (certified new, clean, QC Class) by the USACE contract lab ARI, and delivered to USACE pre-preserved with maleic and ascorbic acid.

The teams first verified each monitoring well location and identification number with project maps and the sample matrix. The teams also verified that work could proceed safely in the vicinity of moving vehicular traffic or other physical, biological, or environmental hazards that may have been present near each monitoring well.

Each team member donned new Nitrile gloves for groundwater sample collection at each well. Once the wells were unlocked and opened, one team member lifted the well riser plug and began hauling the PDB vertically to the surface.

Once each PDB was raised to the surface, the sampling team worked together to carefully cut the top corner off each bag using decontaminated steel scissors. Next, one person held the open sample vials and the other carefully and slowly tilted the bags - open side down - toward each open sample vial. The pre-preserved vials were filled just to overflowing to maintain a reverse meniscus. Then the vials were immediately capped making sure there were no bubbles or headspace per standard VOC sampling procedure. This entire sampling process can be completed within one minute to minimize loss of volatiles while preventing introduction of contaminants into the water from surface sources. After all required vials were filled; any residual sample water remaining in the used PDBs was discharged to ground surface. Therefore, no Investigation-derived waste (IDW) water was generated during this sampling event.

The sampling teams continued use of protective mesh PDB sleeves in wells with steel risers due to a greater potential for damage to the PDB membranes (monitoring wells 12EX01, 12EX02, 14EX03, 14EX04, and 14EX05).

Once recovered and sample water removed, the PDBs and suspension lines were discarded as non-hazardous municipal waste. In addition, gloves, paper towels, bags, and other solid waste materials were disposed of as municipal waste. The PDBs and other solid waste material were placed into a large plastic garbage bag and tied securely prior to disposal. The stainless steel weights were decontaminated and reused during the deployment of the new pre-filled PDBs for the next sampling event.

Significant Observations Made During Passive Diffusion Bag Sampling

Well vaults were found to be flooded and required pumping out with a hand pump to permit sample collection at wells 12BW06, 12CW05, and 12EX02. The 4-inch "J" plug should be replaced in well 12CW05 to keep the well watertight.

Numerous rust particles were observed on the PDBs and PDB suspension lines installed in wells 14EX03 and 14EX04.

No other significant observations were made during this event.

3.0 Investigation-Derived Waste

No investigation-derived waste was generated during this sampling event. All residual PDB water or purged well water was transferred directly to ground surface on each property away from the sample collection point.

4.0 SAMPLE PACKAGING AND DELIVERY

As mentioned in the narrative of each sampling event, groundwater samples were packaged in shipping coolers on ice and under chain of custody for overnight shipment to the USACE contract laboratory Analytical Resources, Inc. during the course of the sampling event.

All sample shipping coolers were prepared for laboratory delivery in the following manner: Each cooler was lined (sides and bottom) with plastic "bubble-wrap" sheets for shock absorption. A large 30-gallon plastic garbage bag was then placed into the cooler to contain the sample water in the event of container breakage during shipment to the laboratories. The glass sample vials were labeled, placed into plastic zip-seal bags, and placed into foam shipping blocks or bubble-wrap bags for shock protection. All the samples were placed in the shipping coolers as indicated on the corresponding chain of custody forms. Gallon size plastic zipper bags of cubed ice bags were placed between and on top of the samples in each cooler to ensure maintenance of the required four degrees Celsius (plus/minus two degrees) sample preservation temperature. The completed chain of custody (COC) forms were placed in gallon size plastic zipper bags and taped to the inside of each cooler lid. Two custody seals were affixed to the outside of each cooler. The custody seals were placed so that the coolers could not be opened without breaking the seals. Each cooler was then securely sealed with fiber tape. The field team ensured drain plugs were securely taped inside and out to prevent possible water leakage.

The laboratory was informed of the sample delivery and ensured the samples were properly accepted and checked in upon receipt the following morning after the sample containers were shipped. All sample coolers and sample containers were accounted for at the contract laboratory following each shipment.

5.0 LABORATORY ANALYSIS

Chemical analyses performed on the samples were as follows: VOCs (Method 524.3).

6.0 DECONTAMINATION PROCEDURES

PDB weights, flow cells and associated tubing, water level indicator meters, and water volume measurement containers used by each team were decontaminated at the end of the project with an Alconox®-water solution followed by triple rinsing using distilled water in the USACE Geology Laboratory.

7.0 PROTECTION LEVEL

All sampling activities were conducted under Worker Protection Level D. For this project, personnel protective equipment included reflective safety vests, safety splash protection glasses, Nitrile gloves, and safety steel toe boots. New pairs of Nitrile gloves were donned prior to handling acid-preserved sample containers and between each unique private well sample point or monitoring well.

End of Field Sampling Report

APPENDIX A

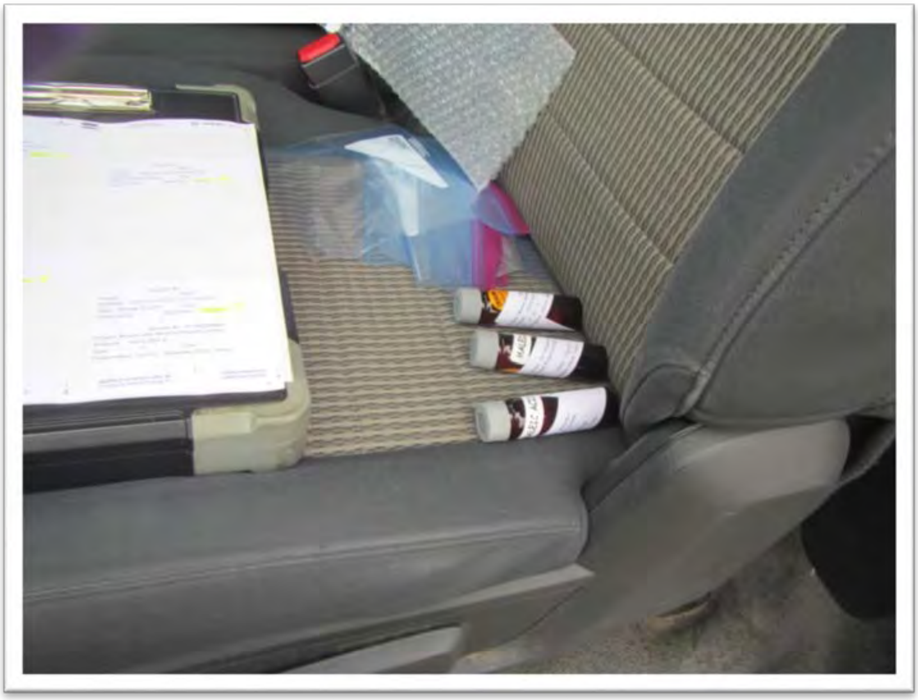
Site and Well Location Maps

(Available in USACE Project Files)

APPENDIX B

Field Sampling Photos

Figure 1



(161115-00AW11-1) Filled and labeled sample vials prior to being bagged and loaded into sample shipping cooler.

Figure 2

(161115-99BW18-1) Jeff Weiss shown monitoring water quality parameters while purging well 99BW18.

Photographer: Joseph Marsh

Figure 3

(161116-04BW04-1) Preparations for deployment of new PDBs. All work is performed on clean aluminum foil.

Figure 4

(161118-00BW11-1) Well 00BW11 shown behind an additional security fence requiring coordination for sampling in the future.

Photographer: Joseph Marsh

US Army Corps of Engineers
Seattle District

Figure 5

(20161115-141951) Door handle tag left after sample collection or if team was unable to collect sample to inform residents who are not at home.

Figure 6

(20161115-142119) Photo of a totalizer gauge monitored and recorded before and after WHF system sampling.

US Army Corps of Engineers
Seattle District

Photographer: Jacob Williams

Figure 7

(20161115-151928) Detail photo of totalizer gauge showing 183,659.5 gallons have passed through the gauge since it was installed.

US Army Corps of Engineers®
Seattle District

Photographer: Jacob Williams

APPENDIX C

Field Notes

SEATTLE DISTRICT, USACE
ENVIRONMENTAL SAMPLING FIELDBOOK

PROJECT: MOSES LAKE WELLFIELD
MONITORING WELL SAMPLING

Book 6

FY16
FY17

NOV 2016

Rite in the Rain®
ALL-WEATHER
ENVIRONMENTAL
FIELD BOOK
№ 550

TEAM 1 FIELD NOTES

Nov SOP

Location Moses Lake, WA Date NOVEMBER 2016 EVENT

Project / Client MOSES LAKE WELLFIELD SUPERFUND SITE

TEAM 1: Joseph Marsh, JEFF WEISS

Groundwater Sampling Table

SAMPLE ID		WELL	2016 SAMPLE DATE	TIME	Analysis VOCs (524.3)	
1611N99AW01		99AW01	11-14	1428	3	
1611N92BW01		92BW01	11-15	0835	3	
1611N00AW11		00AW11	11-15	0904	3	
1611N92BW02		92BW02	11-15	0937	3	
1611N91BW04		91BW04	11-15	1016	3	
1611N99AW09		99AW09	11-15	1142	9	MS MSD
1611D99AW09	FD	99AW09	11-15	1158	3	
1611N99BW18		99BW18	11-15	1116	3	
1611N99BW10		99BW10	11-15	1316	3	
1611N12CW04		12CW04	11-16	1045	3	
1611N12BW05		12BW05	11-16	1026	3	
1611N04CW05		04CW05	11-16	1111	3	
1611N12EX01		12EX01	11-16	1308	3	
1611N12BW07		12BW07	11-16	1249	3	
1611N04BW09		04BW09	11-16	1336	3	
1611N14EX05		14EX05	11-16	1415	3	
1611N14BW03		14BW03	11-16	1357	3	
1611N12CW03		12CW03	11-16	1441	3	
1611N12BW04A		12BW04A	11-16	1505	3	
1611N12BW04B		12BW04B	11-16	1515	3	
1611N14EX03		14EX03	11-16	1621	3	

Location Date

Project / Client Moses Lake Wellfield NOV 2016 Sampling table Continued (Team 1)

SAMPLE ID		WELL	DATE	TIME	Analysis: VOCs (524.3)	
1611N14BW01		14BW01	11-17	0806	9	MS MSD
1611D14BW01	FD	14BW01	11-17	0820	3	
1611N14EX04		14EX04	11-17	0900	3	
1611N14BW02		14BW02	11-17	0825	3	
1611N12CW02		12CW02	11-17	0915	3	
1611N12BW03A		12BW03A	11-17	0936	3	
1611N12BW03B		12BW03B	11-17	0940	3	
1611N12BW06		12BW06	11-17	1035	9	MS MSD
1611D12BW06	FD	12BW06	11-17	1050	3	
1611N12CW05		12CW05	11-17	1058	3	
1611N12BW08		12BW08	11-17	1200	3	
1611N12EX02		12EX02	11-17	1218	3	
1611N12CW01		12CW01	11-17	1136	3	
1611N12BW02		12BW02	11-17	1121	3	
1611N02BW01		02BW01	11-17	1322	3	
1611N04CW07A		04CW07A	11-17	1343	3	
1611N04CW07B		04CW07B	11-17	1350	3	
1611PDTB01		Pre deploy TB	11-16	0830	3	PDB trip
1611FBMW01		Field Blank	11-17	1402	3	
1611TB03		TB	11-15	1500	~~3~~ 2	
1611TB04		TB	11-16	0915	~~3~~ 2	
1611TB05		TB	11-17	0936	~~3~~ 2	

Vol 5015

Location
Date 11-14-16
Project / Client Moses Lake Wellfield
November 2016 event
GW Sampling
Team 1

FIELD NOTES
Joseph Marsh + Jeff Weiss on site —
1200 - site tour - well familiarization -
1300 - P/U 15Lb. CO_2 Cylinder at OXARC
1341 → setup at 99AW01 - calibrate flow cell, pre purge, then micropurge to stability
1426 = Sample time - No problems noted.
close + lock well. samples kept on ice under chain of custody overnight.
- site tour + inspection of drilling site
Note - well site 04CW08 Now has chain link fence surrounding property with locked gate. check to ensure we have access to property. New ROE form will likely have to be signed.
1600 - end of day.

11-15-16
0730 - calibrated flow cell - Mob. to site
0815 - 92BW01 setup - prepurging, then micropurge to stability
0835 - Sample time, close + lock well
Mob. to 08AW11 purged to stability
No issues noted.
0904 Sample time, close + lock well.

Location
Date 11-15-16

Project / Client Moses Lake Wellfield
GW Sampling Team 1

Field Notes Continued
Mob. to 92BW02 yellow jackets in pro. casing. - long reach for air line
Micropurge to stability after pre purge
0937 = Sample time, close + lock well
Mob. to 91BW04 pre purge then micropurge to stability
1016 = Sample time, close + lock well.
Setup at 99BW18 - prepurging
- Throttle set higher than Normal - 60psi
Micropurge to stability
1116 = Sample time, Close + lock well.
Mob. over to 99AW09 - pre purging
Then Micropurge to stabilization
1142 = Sample time (P/MS MSD) 1158 = (FD Time)
1210 -
1240 Lunch

1250 - Mob. to 99BW10, flush mount well
90psi to drive pump - pre purge
then micropurge to stability
1316 = Sample time, Close + lock well.
Changeover to PDB deployments - Samples kept on ice under COC.
04CW01 PDB deployed (22cm)
↳

Location

Date 11-15-16 11-16-16

Project / Client Moses Lake Wellfield

Field Notes cont. Team 1

1500 - 04BW01 PDB installed - one 220 ml.
wells closed + locked
—Northern end well tour - Crab Creek area,

1600 - end of day

11-16-2016

PDB installation begins

0800 04BW04 ✓
04CW02 ✓
04BW05 ✓
04BW06 ✓
04CW03 ✓
91AW07 ✓
12BW01 ✓
No problems noted.

1016 - 12BW05 SWL = 88.22'
PDB pulled for Sampling
1026 sample time - New 220 ml
PDB deployed,

12CW04 SWL = 99.84' → 2 330 ml - PDBs installed
PDB pulled for Sampling, Sample time 1045

Set up @ 04CW05 SWL = 97.71'
PDB pulled - sample time 1111 hrs
New 220 ml PDB installed

Location

Date 11-16-16

Project / Client Moses Lake Wellfield
Team 1 Notes cont.

1230 - 12BW07 SWL = 87.65'
pulled PDB, Sample time = 1249
Deployed New 220 ml PDB. close/lock well
→ 2 330 ml Bags found in well.

12EX01 SWL = 87.70'
pulled PDB for sampling Sample time = 1308
Installed one 220 ml PDB
Close + lock wells

04BW09 SWL = 83.53'
Sample time 1336 - redeploy new
220 ml PDB

1349 - 14BW03 SWL = 85.82'
pulled PDB, sample time = 1357
deploy New bag, close + lock well

14EX05 SWL = 85.76'
pulled PDB Sample time = 1415

1432 · 12CW03 SWL = 106.74'
pulled PDB, sample time = 1441

12BW04 SWL = 97.64'
dual zone - 2 PDBs pulled
A Time: 1505 B time = 1515

Location Date 11-16-16

Project / Client Moses Lake Wellfield 11-17-16

Team / Notes cont

04BW07 Dropping PDB - 220 ml. (Deploying)

04CW04 Dropping PDB 220 ml, (Deploying)

1611 14EX03 SWL = 93.94'
PDB pulled sample time = 1621

1630 - Drove by Airport well 00BW11 -
Noted New security fence surrounding
well site - must coordinate with Port in Jan.
for JAN 17 sampling event for access.

→ 11-17-16

14BW01 SWL = 93.62'
PDB pulled (2x330)
(P) Sample time 0806 (FD) 0820
one Bag deployed - close + lock well

14BW02 SWL = 104.58'
PDB pulled sample time = 0825

14EX04 SWL = 104.80'
PDB pulled sample time 0900
PDB installed - close + lock wells

Location Date

Project / Client Moses Lake Wellfield

Team / Notes cont.

12CW02 SWL = 153.89'
PDB pulled Sample time = 0915
PDB 220ml installed = 2 weights

12BW03 SWL = 125.31'
Dual interval PDBs pulled
interval A = 0936 Sample time
Interval B = 0940 Sample time
Dual interval PDBs installed 220 ml each

12BW06 SWL = ~~10~~ 114.27' Vault flooded
PDBs - 2 330 ml for P/MS/MSD/FD
(P) Time = 1035 (FD) Time = 1050
securely close well cap

12CW05 SWL = 140.14'
PDBs removed for sampling Sample Time = 1058
installed new PDB.
* Vault flooded - water pumped out (* Needs new "J" Plug 4")

12BW02 SWL = 112.85'
PDB pulled Sample time 1121
New 220ml PDB installed - well
closed securely.

12CW01 SWL = 134.92'
pulled PDB - sample time = 1136
replaced New PDB in well.

Location Date 11-17-16

Project / Client Moses Lake Well field

Team / Water Cont.

12BW08 SWL = 115.73'

PDB pulled for sampling

Sample time = 1200)

~~12EX~~ Close + secure well

12EX02 SWL = 115.88'

PDB pulled for sampling

1218 = Sample time, Deploy New 220mL PDB

close + Bolt down Vault cover plate

(water in vault removed with

hand pump.)

Lunch Break

02BW01 SWL = 129.26'

pulled PDB for sampling

1322 = Sample time, deploy new bag.

close + secure well.

04CW07 SWL = 146.0'

PDBs (2 intervals) retrieved for

Sampling A time = 1343

B Time = 1350

Deploy 2 PDBs per plan

1500 - Field Work Complete

1600 - Shipped 3 sample coolers to ARI via Airport Fedex.

11-18-16 - Return to District Office mission complete

Location Date

Project / Client

Location Moses Lake Date 11/15/16

Project / Client MLW Well Field

Jake, peter

1200 Arrived at WP27.
15.2°C starting temp.

WP27

Time	0	2	4	6	8
Temp (C)	15.2	15.2	15.1	15.0	

2 ~~gal~~ PG
2 gal purged. Sample taken at 12:45.
Duplicate at 12:47

WP125 Arrived at 1:40
Totalizer 634562.0

Time	0	2	4	6
Temp	14.2	14.2	14.3	14.0

Purge from spigot on front side of well house
3 gal purged
Sample taken at 1:55

Location Date 11/15/16

Project / Client MLW

Jake, peter

WP124 Arrived 2:05

Time	0	2	4	6
Temp	14.7	14.6	14.7	14.7

Purge from spigot on side of house
Sample taken at 2:15

Totalizer - 313180.1

WP121 Arrived 2:27

Time	0	2	4	6	8
Temp.	12.1	13.4	13.5	13.4	13.4

Purged 10 gal.
Totalizer: 83562.5 gal
Sample time:
A: 1442
B: 1444
C: 1446

Location MW Nov. '16 Date 11/15/16

Project / Client

peter, Jake

1500: Arrived at WP-129

Time	0	2	4	6	8	10	12
Temp	18.9	18.3	18.1	18.0	17.8	17.7	17.7

purged 25 gal.

Totalizer: 183659.7

Sample time: 1520

1556: Arrived at WP-70
Totalizer: 267749.4

Time:	0	2	4	6	8
Temp:	15.5	15.2	15.4	15.5	15.4

Purged 10 gal.
Sampletime: 1605

Location Moses Lake '16 Date 11/16/16

Project / Client
Peter, Jake

WP14 Arrived 8:40
Purge started 8:45

Time	0	2	4	6	8	10
Temp	20.0	19.8	19.6	19.9	19.8	19.8

15 gal purged

Totalizer 2159368.5
Samples taken at 8:55.

0905: Arrived at WP-83

Purge started at 9:15.

Time	0	2	4	6
Temp	13.5	13.5	13.5	13.5

10 gal purged
Samples taken at 9:30
Totalizer: 2367352.0

Location MLW Nov. '16 Date 11/16/16

Project / Client
Peter, Jake

0955: Arrived at WP-04
- Big pile of gravel blocking well house; had to climb over side.

Time	0	2	4	6
Temp	16.0	16.0	16.0	15.9

Purge 3 gal.

Sample time: 1007

1020: Arrived at WP-86
10:25 Purge started

Time	0	2	4	6	8
Temp	13.6	13.3	13.2	13.2	13.2

8 gal purged
Totalizer: 729763.9
Samples taken at 10:40

Location MLW Nov. '16 Date 11/16/16

Project / Client
peter, Jake

1100: Arrived at WP-119

Time	0	2	4	6
Temp	13.2	13.3	13.3	13.3

Pursed 10 gal.

Totalizer: 216945.1 gal.
Sample times:
A: 1109
B 1111
C: 1113

1130: Arrived at WP-123

Purge Started at 11:35

Time	0	2	4	6	8	10	12
Temp	11.5	12.0	12.2	12.4	12.4	12.4	

Purged 13 gal
Totalizer: 565982.7
Sample times: A: 1147 B: 1149 C: 1151
DUP: 1151

Project / Client
peter, Jake

1420: Arrived at WP-131

Time	0	2	4	6	8
Temp	14.3	14.6	13.5	13.9	14.1

Time	10	12	14	16
Temp	14.5	14.5	14.5	

Purged 20 gal.

Sample time: 1435

1445: Arrived at WP-167

Time	0	2	4	6
Temp	14.9	~~15~~15.0	15.0	15.0

Purged 18 gal.
Sample time: 1453

Project / Client
peter, Jake

1500: Arrived at WP-168

1505 Purged started

Time	0	2	4	6
Temp	14.7	14.7	14.7	14.7

10 gal purged

Sample taken at 15:11

APPENDIX B – Comprehensive 2016 Analytical Results

Chemical Name				1,1,1-TCA	1,1-DCA	1,1-DCE	1,2-DCA	cis-1,2-DCE	trans-1,2-DCE	TCE	VC	Ben-zene	Ethyl-benzene	Toluene	m,p-xylene	o-xylene	DRO	GRO	MRO	PFOS	PFOA	PFHpA	PFNA	PFBS	PFHxS	1,4 -dioxane
Analysis Method				EPA Method 524																EPA Method 537						Method 522
CAS RN				71-55-6	75-34-3	75-35-4	107-06-2	156-59-2	156-60-5	79-01-6	75-01-4	71-43-2	100-41-4	108-88-3	179601-23-1	95-47-6	DRO	GRO	MOIL	1763-23-1	335-67-1	375-85-9	375-95-1	375-73-5	355-46-4	123-91-1
MCL				µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Well ID	Sample Name	Sample Type	Sample Date																							
Monitoring Wells																										
00AW11	1605N00AW11	N	5/21/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	1.32	0.05 U															
00AW11	1611N00AW11	N	11/15/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	1.64	0.10 U															
00BW01	1605N00BW01	N	5/16/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	0.06 U	0.05 U															
00BW02	1605N00BW02	N	5/17/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	0.19 J	0.05 U															
00BW03	1605N00BW03	N	5/17/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	0.06 U	0.05 U															
00BW04	1605N00BW04	N	5/16/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	0.06 U	0.05 U															
00BW05	1605N00BW05	N	5/16/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	0.06 U	0.05 U															
00BW05	1605D00BW05	FD	5/16/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	0.06 U	0.05 U															
00BW06	1605N00BW06	N	5/17/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	0.07 J	0.05 U															
00BW07	1605N00BW07	N	5/17/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	0.06 U	0.05 U															
00BW09	1605N00BW09	N	5/16/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	0.06 U	0.05 U															
00BW10	1605N00BW10	N	5/20/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	0.06 U	0.05 U															0.03 J
00BW11	1605N00BW11	N	5/17/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	0.06 U	0.05 U	0.03	0.04 U	0.04 U	0.05 U	0.04 U	100	9.06 U	60 U							
00BW11	1605D00BW11	FD	5/17/2016									0.03	0.04 U	0.04 U	0.05 U	0.04 U	100	9.06 U	60 U							
00BW12	1605N00BW12	N	5/18/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	17.0	0.05 U															0.09
00BW13	1605N00BW13	N	5/22/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	0.06 U	0.05 U															
00BW14	1605N00BW14	N	5/16/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	0.06 U	0.05 U															
00BW15	1605N00BW15	N	5/19/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.38	0.07 U	1.97	0.05 U															0.06 U
00BW16	1605N00BW16	N	5/23/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	0.06 U	0.05 U															
00BW16	1605D00BW16	FD	5/23/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	0.06 U	0.05 U															
01BW01	1605N01BW01	N	5/16/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	0.06 U	0.05 U															
02BW01	1602N02BW01	N	2/24/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	10.9	0.10 U															
02BW01	1605N02BW01	N	5/20/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	10.7	0.05 U															0.06 U
02BW01	1605D02BW01	FD	5/20/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	9.99	0.05 U															
02BW01	1611N02BW01	N	11/17/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	11.1	0.10 U															
02BW02	1605N02BW02	N	5/20/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	0.07 J	0.05 U															
04BW01	1605N04BW01	N	5/16/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	0.06 U	0.05 U															
04BW04	1605N04BW04	N	5/18/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	0.30	0.05 U									0.0112 J	0.00627 J	0.00262 J	0.0200 U	0.0900 U	0.0217 J	
04BW05	1605N04BW05	N	5/19/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 J	0.07 U	2.66	0.05 U															0.06 U
04BW06	1605N04BW06	N	5/20/2016	0.04 U	0.07 U	0.06 U	0.07 U	2.74	0.07 U	13.2	0.05 U															
04BW07	1605N04BW07	N	5/22/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	0.06 U	0.05 U															
04BW09	1602N04BW09	N	2/24/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	21.8	0.10 U															
04BW09	1605N04BW09	N	5/22/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	20.1	0.05 U															
04BW09	1611N04BW09	N	11/16/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	24.0	0.10 U															
04CW01	1605N04CW01	N	5/18/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	0.44	0.05 U									0.052	0.105	0.0169	0.0200 U	0.0318 J	0.252	
04CW01	1605D04CW01	FD	5/18/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	0.48	0.05 U									0.0711	0.14	0.0215	0.0200 U	0.0423 J	0.334	
04CW02	1605N04CW02	N	5/19/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	0.06 J	0.05 U															
04CW03	1605N04CW03	N	5/21/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	2.05	0.05 U															

APPENDIX B – Comprehensive 2016 Analytical Results

Chemical Name				1,1,1-TCA	1,1-DCA	1,1-DCE	1,2-DCA	cis-1,2-DCE	trans-1,2-DCE	TCE	VC	Ben-zene	Ethyl-benzene	Toluene	m,p-xylene	o-xylene	DRO	GRO	MRO	PFOS	PFOA	PFHpA	PFNA	PFBS	PFHxS	1,4 -dioxane
Analysis Method				EPA Method 524																EPA Method 537						Method 522
CAS RN				71-55-6	75-34-3	75-35-4	107-06-2	156-59-2	156-60-5	79-01-6	75-01-4	71-43-2	100-41-4	108-88-3	179601-23-1	95-47-6	DRO	GRO	MOIL	1763-23-1	335-67-1	375-85-9	375-95-1	375-73-5	355-46-4	123-91-1
MCL				µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Well ID	Sample Name	Sample Type	Sample Date																							
04CW04	1605N04CW04	N	5/22/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	0.40	0.05 U															
04CW05	1602N04CW05	N	2/24/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	2.38	0.10 U															
04CW05	1605N04CW05	N	5/22/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	2.41	0.05 U															
04CW05	1605D04CW05	FD	5/22/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	2.07	0.05 U															
04CW05	1611N04CW05	N	11/16/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	2.25	0.10 U															
04CW07	1602N04CW07A	N	2/24/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	5.52	0.10 U															
04CW07	1602N04CW07B	N	2/24/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	5.73	0.10 U															
04CW07	1605N04CW07A	N	5/23/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	6.01	0.05 U															
04CW07	1605N04CW07B	N	5/23/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	5.66	0.05 U															
04CW07	1611N04CW07A	N	11/17/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	5.79	0.10 U															
04CW07	1611N04CW07B	N	11/17/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	6.10	0.10 U															
04CW08	1605N04CW08	N	5/23/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	0.06 U	0.05 U															
12BW01	1605N12BW01	N	5/22/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	0.06 U	0.05 U															
12BW02	1602N12BW02	N	2/22/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	8.45	0.10 U															
12BW02	1605N12BW02	N	5/20/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	7.77	0.05 U															0.06 U
12BW02	1611N12BW02	N	11/17/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	7.89	0.10 U															
12BW03	1602N12BW03A	N	2/23/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	1.62	0.10 U															
12BW03	1602N12BW03B	N	2/23/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.65	0.10 U															
12BW03	1605N12BW03A	N	5/22/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	0.94	0.05 U															
12BW03	1605N12BW03B	N	5/22/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	0.51	0.05 U															
12BW03	1611N12BW03A	N	11/17/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.61	0.10 U															
12BW03	1611N12BW03B	N	11/17/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.47	0.10 U															
12BW04	1602N12BW04A	N	2/24/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	18.2	0.10 U															
12BW04	1602N12BW04B	N	2/24/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	19.0	0.10 U															
12BW05	1605N12BW05	N	5/22/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	85.5	0.05 U															
12BW04	1605N12BW04A	N	5/22/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	17.3	0.05 U															
12BW04	1605N12BW04B	N	5/22/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	20.2	0.05 U															
12BW04	1611N12BW04A	N	11/16/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	20.8	0.10 U															
12BW04	1611N12BW04B	N	11/16/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	20.6	0.10 U															
12BW05	1602N12BW05	N	2/24/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	79.9	0.10 U															
12BW05	1611N12BW05	N	11/16/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	92.2	0.10 U															
12BW06	1602N12BW06	N	2/23/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	6.73	0.10 U															
12BW06	1602D12BW06	FD	2/23/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	6.28	0.10 U															
12BW06	1605N12BW06	N	5/23/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	4.84	0.05 U															
12BW06	1611N12BW06	N	11/17/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	6.20	0.10 U															
12BW06	1611D12BW06	FD	11/17/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	5.91	0.10 U															
12BW07	1602N12BW07	N	2/24/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	63.8	0.10 U															
12BW07	1605N12BW07	N	5/19/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	75.3	0.05 U															0.06 U
12BW07	1611N12BW07	N	11/16/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	71.0	0.10 U															
12BW08	1602N12BW08	N	2/22/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	9.38	0.10 U															
12BW08	1605N12BW08	N	5/23/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	7.45	0.05 U															

APPENDIX B – Comprehensive 2016 Analytical Results

Chemical Name				1,1,1-TCA	1,1-DCA	1,1-DCE	1,2-DCA	cis-1,2-DCE	trans-1,2-DCE	TCE	VC	Ben-zene	Ethyl-benzene	Toluene	m,p-xylene	o-xylene	DRO	GRO	MRO	PFOS	PFOA	PFHpA	PFNA	PFBS	PFHxS	1,4 -dioxane
Analysis Method				EPA Method 524																EPA Method 537						Method 522
CAS RN				71-55-6	75-34-3	75-35-4	107-06-2	156-59-2	156-60-5	79-01-6	75-01-4	71-43-2	100-41-4	108-88-3	179601-23-1	95-47-6	DRO	GRO	MOIL	1763-23-1	335-67-1	375-85-9	375-95-1	375-73-5	355-46-4	123-91-1
MCL				µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Well ID	Sample Name	Sample Type	Sample Date																							
12BW08	1611N12BW08	N	11/17/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	8.87	0.10 U															
12CW01	1602N12CW01	N	2/22/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	3.74	0.10 U															
12CW01	1605N12CW01	N	5/23/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	3.16	0.05 U															
12CW01	1611N12CW01	N	11/17/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	3.61	0.10 U															
12CW02	1602N12CW02	N	2/23/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.37	0.10 U															
12CW02	1605N12CW02	N	5/22/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	0.33	0.05 U															
12CW02	1611N12CW02	N	11/17/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.29 U	0.10 U															
12CW03	1602N12CW03	N	2/24/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.28	0.10 U															
12CW03	1605N12CW03	N	5/22/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	0.31	0.05 U															
12CW03	1611N12CW03	N	11/16/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.30 U	0.10 U															
12CW04	1602N12CW04	N	2/24/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.51	0.10 U															
12CW04	1605N12CW04	N	5/22/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	0.44	0.05 U															
12CW04	1611N12CW04	N	11/16/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.52	0.10 U															
12CW05	1602N12CW05	N	2/23/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.80	0.10 U															
12CW05	1605N12CW05	N	5/23/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	0.65	0.05 U															
12CW05	1611N12CW05	N	11/17/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.62	0.10 U															
12EX01	1602N12EX01	N	2/24/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.27	0.10 U	6.58	0.10 U															
12EX01	1605N12EX01	N	5/22/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.28	0.07 U	5.46	0.05 U															
12EX01	1611N12EX01	N	11/16/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.18 J	0.10 U	4.21	0.10 U															
12EX02	1602N12EX02	N	2/22/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	4.81	0.10 U															
12EX02	1605N12EX02	N	5/23/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	5.02	0.05 U															
12EX02	1611N12EX02	N	11/17/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	4.47	0.10 U															
14BW01	1602N14BW01	N	2/23/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	59.0	0.10 U															
14BW01	1605N14BW01	N	5/19/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	68.3	0.05 U															0.06 U
14BW01	1611N14BW01	N	11/17/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	59.5	0.10 U															
14BW01	1611D14BW01	FD	11/17/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	59.1	0.10 U															
14BW02	1602N14BW02	N	2/23/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	22.2	0.10 U															
14BW02	1605N14BW02	N	5/22/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	21.9	0.05 U															
14BW02	1611N14BW02	N	11/17/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	20.5	0.10 U															
14BW03	1602N14BW03	N	2/24/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	9.35	0.10 U															
14BW03	1602D14BW03	FD	2/24/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	9.11	0.10 U															
14BW03	1605N14BW03	N	5/22/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	9.17	0.05 U															
14BW03	1611N14BW03	N	11/16/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	9.98	0.10 U															
14EX03	1602N14EX03	N	2/23/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.35	0.10 U	32.4	0.10 U															
14EX03	1605N14EX03	N	5/22/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.34	0.07 U	35.4	0.05 U															
14EX03	1605D14EX03	FD	5/22/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.36	0.07 U	37.3	0.05 U															
14EX03	1611N14EX03	N	11/16/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.40	0.10 U	35.4	0.10 U															
14EX04	1602N14EX04	N	2/23/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	18.7	0.10 U															
14EX04	1605N14EX04	N	5/22/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	17.2	0.05 U															
14EX04	1611N14EX04	N	11/17/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	16.5	0.10 U															
14EX05	1602N14EX05	N	2/24/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.15 J	0.10 U	3.61	0.10 U															

APPENDIX B – Comprehensive 2016 Analytical Results

Chemical Name				1,1,1-TCA	1,1-DCA	1,1-DCE	1,2-DCA	cis-1,2-DCE	trans-1,2-DCE	TCE	VC	Ben-zene	Ethyl-benzene	Toluene	m,p-xylene	o-xylene	DRO	GRO	MRO	PFOS	PFOA	PFHpA	PFNA	PFBS	PFHxS	1,4 -dioxane
Analysis Method				EPA Method 524																EPA Method 537						Method 522
CAS RN				71-55-6	75-34-3	75-35-4	107-06-2	156-59-2	156-60-5	79-01-6	75-01-4	71-43-2	100-41-4	108-88-3	179601-23-1	95-47-6	DRO	GRO	MOIL	1763-23-1	335-67-1	375-85-9	375-95-1	375-73-5	355-46-4	123-91-1
MCL				µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Well ID	Sample Name	Sample Type	Sample Date																							
14EX05	1605N14EX05	N	5/22/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.13 J	0.07 U	3.67	0.05 U															
14EX05	1611N14EX05	N	11/16/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.13 J	0.10 U	4.57	0.10 U															
91AW07	1605N91AW07	N	5/21/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	0.10 J	0.05 U															
91AW09	1605N91AW09	N	5/20/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	0.18 J	0.05 U															
91AW14	1605N91AW14	N	5/18/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	3.94	0.05 U									0.119	0.143	0.0196	0.0592	0.0765	0.395	
91AW15	1605N91AW15	N	5/17/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	0.06 J	0.05 U															
91AW17	1605N91AW17	N	5/19/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	0.15 J	0.05 U															
91BW02	1605N91BW02	N	5/17/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	0.06 U	0.05 U															
91BW03	1605N91BW03	N	5/20/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	26.6	0.05 U															
91BW04	1602N91BW04	N	2/23/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.24	0.10 U															
91BW04	1605N91BW04	N	5/22/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	0.15 J	0.05 U															
91BW04	1611N91BW04	N	11/15/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.15 U	0.10 U															
92BW01	1602N92BW01	N	2/23/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	25.6	0.10 U															
92BW01	1602D92BW01	FD	2/23/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	25.3	0.10 U															
92BW01	1605N92BW01	N	5/21/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	21.0	0.05 U															
92BW01	1605D92BW01	FD	5/21/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	21.8	0.05 U															
92BW01	1611N92BW01	N	11/15/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	21.9	0.10 U															
92BW02	1605N92BW02	N	5/21/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.74	0.07 U	7.27	0.05 U															
92BW02	1611N92BW02	N	11/15/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.87	0.10 U	8.21	0.10 U															
99AW01	1605N99AW01	N	5/21/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	0.06 U	0.05 U															
99AW01	1611N99AW01	N	11/14/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.13 U	0.10 U															
99AW08	1605N99AW08	N	5/20/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	0.16 J	0.05 U															
99AW09	1605N99AW09	N	5/23/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	1.74	0.05 U															
99AW09	1611N99AW09	N	11/15/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	2.38	0.10 U															
99AW09	1611D99AW09	FD	11/15/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	2.13	0.10 U															
99BW01	1605N99BW01	N	5/19/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	32.2	0.05 U															0.1
99BW09	1605N99BW09	N	5/21/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	0.06 U	0.05 U															
99BW10	1602N99BW10	N	2/23/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	14.9	0.10 U															
99BW10	1605N99BW10	N	5/23/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	12.0	0.05 U															
99BW10	1611N99BW10	N	11/15/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	12.0	0.10 U															
99BW11	1605N99BW11	N	5/23/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	0.06 U	0.05 U															
99BW12	1605N99BW12	N	5/19/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	0.36 U	0.05 U															0.05 J
99BW12	1605D99BW12	FD	5/19/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	0.34 U	0.05 U															
99BW14	1605N99BW14	N	5/21/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	0.06 U	0.05 U															
99BW15	1605N99BW15	N	5/18/2016	0.04 U	0.07 U	0.06 U	0.07 U	1.71	0.07 U	7.16	0.05 U															0.25
99BW16	1605N99BW16	N	5/18/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	1.14	0.05 U									0.348	0.336	0.0427	0.0201	0.162	0.718	0.03
99BW18	1602N99BW18	N	2/23/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	9.12	0.10 U															
99BW18	1605N99BW18	N	5/23/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	6.49	0.05 U															
99BW18	1611N99BW18	N	11/15/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	6.62	0.10 U															
Private Wells																										
WP-03	1605DWP03	FD	5/16/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.23	0.07 U	1.06	0.05 U															

APPENDIX B – Comprehensive 2016 Analytical Results

Chemical Name				1,1,1-TCA	1,1-DCA	1,1-DCE	1,2-DCA	cis-1,2-DCE	trans-1,2-DCE	TCE	VC	Ben-zene	Ethyl-benzene	Toluene	m,p-xylene	o-xylene	DRO	GRO	MRO	PFOS	PFOA	PFHpA	PFNA	PFBS	PFHxS	1,4 -dioxane
Analysis Method				EPA Method 524																EPA Method 537						Method 522
CAS RN				71-55-6	75-34-3	75-35-4	107-06-2	156-59-2	156-60-5	79-01-6	75-01-4	71-43-2	100-41-4	108-88-3	179601-23-1	95-47-6	DRO	GRO	MOIL	1763-23-1	335-67-1	375-85-9	375-95-1	375-73-5	355-46-4	123-91-1
MCL				µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Well ID	Sample Name	Sample Type	Sample Date																							
WP-03	1605NWP03	N	5/16/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.23	0.07 U	1.16	0.05 U															
WP-04	1602NWP04	N	2/22/2016	0.10 U	0.10 U	0.10 U	0.10 U	2.08	0.10 U	6.14	0.10 U															
WP-04	1605NWP04	N	5/17/2016	0.04 U	0.07 U	0.06 U	0.07 U	2.09	0.07 U	6.23	0.05 U															
WP-04	1608NWP04	N	8/17/2016	0.20 U	0.20 U	0.20 U	0.20 U	1.89	0.20 U	5.84	0.20 U															
WP-04	1611NWP04	N	11/16/2016	0.10 U	0.10 U	0.10 U	0.10 U	1.98	0.10 U	5.92	0.10 U															
WP-09	1605NWP09	N	5/17/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	0.06 U	0.05 U															
WP-10	1605NWP10	N	5/16/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	0.06 U	0.05 U															
WP-105	1605NWP105	N	5/16/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	0.45	0.05 U															
WP-111	1605NWP111	N	5/18/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	0.22	0.05 U															
WP-111	1605DWP111	FD	5/18/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	0.20	0.05 U															
WP-116	1605NWP116	N	5/16/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.46	0.07 U	1.92	0.05 U															
WP-120	1605NWP120	N	5/16/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	0.35	0.05 U															
WP-122	1605NWP122	N	5/16/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	0.17 J	0.05 U															
WP-126	1605NWP126	N	5/16/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.14 J	0.07 U	0.99	0.05 U															
WP-127	1605NWP127	N	5/16/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	0.89	0.05 U															
WP-128	1605NWP128	N	5/17/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	0.42	0.05 U															
WP-130	1605NWP130	N	5/16/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	0.45	0.05 U															
WP-131	1602NWP131	N	2/24/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.88	0.10 U															
WP-131	1605NWP131	N	5/17/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.11 J	0.07 U	3.12	0.05 U															
WP-131	1608NWP131	N	8/17/2016	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	1.69	0.20 U															
WP-131	1611NWP131	N	11/16/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	1.30	0.10 U															
WP-136	1605NWP136	N	5/16/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	1.19	0.05 U															
WP-137	1605NWP137	N	5/17/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	1.31	0.05 U															
WP-138	1605NWP138	N	5/16/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	0.55	0.05 U															
WP-139	1605NWP139	N	5/16/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	0.80	0.05 U															
WP-143	1605NWP143	N	5/17/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	0.57	0.05 U															
WP-144	1605NWP144	N	5/18/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	0.25	0.05 U															0.04 J
WP-145	1605NWP145	N	5/16/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	0.32	0.05 U															
WP-147	1605NWP147	N	5/17/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	0.16 J	0.05 U															
WP-148	1605NWP148	N	5/18/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	0.16 J	0.05 U															
WP-149	1605NWP149	N	5/17/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	0.07 J	0.05 U															
WP-150	1605NWP150	N	5/17/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	0.08 J	0.05 U															
WP-152	1605NWP152	N	5/16/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	0.20	0.05 U															
WP-153	1605NWP153	N	5/18/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	0.26	0.05 U															
WP-153	1605DWP153	FD	5/18/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	0.25	0.05 U															
WP-154	1605NWP154	N	5/18/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	0.29	0.05 U															
WP-155	1605NWP155	N	5/16/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	0.29	0.05 U															
WP-156	1605NWP156	N	5/16/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	0.38	0.05 U															
WP-165	1605NWP165	N	5/16/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	0.16 J	0.05 U															
WP-167	1602NWP167	N	2/23/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	1.35	0.10 U															
WP-167	1605NWP167	N	5/16/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	2.21	0.05 U															

APPENDIX B – Comprehensive 2016 Analytical Results

Chemical Name				1,1,1-TCA	1,1-DCA	1,1-DCE	1,2-DCA	cis-1,2-DCE	trans-1,2-DCE	TCE	VC	Ben-zene	Ethyl-benzene	Toluene	m,p-xylene	o-xylene	DRO	GRO	MRO	PFOS	PFOA	PFHpA	PFNA	PFBS	PFHxS	1,4 -dioxane
Analysis Method				EPA Method 524																EPA Method 537						Method 522
CAS RN				71-55-6	75-34-3	75-35-4	107-06-2	156-59-2	156-60-5	79-01-6	75-01-4	71-43-2	100-41-4	108-88-3	179601-23-1	95-47-6	DRO	GRO	MOIL	1763-23-1	335-67-1	375-85-9	375-95-1	375-73-5	355-46-4	123-91-1
MCL				µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Well ID	Sample Name	Sample Type	Sample Date																							
WP-167	1608NWP167	N	8/17/2016	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	2.17	0.20 U															
WP-167	1611NWP167	N	11/16/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	1.80	0.10 U															
WP-168	1602NWP168	N	2/23/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	2.04	0.10 U															
WP-168	1605NWP168	N	5/16/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	2.04	0.05 U															
WP-168	1605DWP168	FD	5/16/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	2.47	0.05 U															
WP-168	1608NWP168	N	8/17/2016	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	2.26	0.20 U															
WP-168	1611NWP168	N	11/16/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	2.47	0.10 U															
WP-169	1605NWP169	N	5/16/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	1.51	0.05 U															
WP-170	1605NWP170	N	5/18/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	0.71	0.05 U															
WP-171	1605NWP171	N	5/18/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	0.06 U	0.05 U															
WP-172	1605NWP172	N	5/16/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	0.47	0.05 U															
WP-173	1605NWP173	N	5/18/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	0.06 U	0.05 U															
WP-177	1605NWP177	N	5/16/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	0.07 J	0.05 U															
WP-178	1605NWP178	N	5/16/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	0.21	0.05 U															
WP-179	1605NWP179	N	5/16/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	0.09 J	0.05 U															
WP-180	1605NWP180	N	5/18/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	0.06 J	0.05 U															
WP-27	1602NWP27	N	2/24/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	1.36	0.10 U															
WP-27	1602DWP27	FD	2/24/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	1.34	0.10 U															
WP-27	1605NWP27	N	5/17/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	1.66	0.05 U															
WP-27	1608NWP27	N	8/16/2016	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	1.56	0.20 U															
WP-27	1611NWP27	N	11/15/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	1.25	0.10 U															
WP-27	1611DWP27	FD	11/15/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	1.43	0.10 U															
WP-28	1605NWP28	N	5/17/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	1.57	0.05 U															
WP-33	1605NWP33	N	5/18/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	0.60	0.05 U															
WP-45	1605NWP45	N	5/18/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	0.70	0.05 U															0.06 U
WP-45	1605DWP45	FD	5/18/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	0.73	0.05 U															0.06 U
WP-50	1605NWP50	N	5/17/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	0.06 U	0.05 U															
WP-52	1605NWP52	N	5/17/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	0.17 J	0.05 U															0.06 U
WP-52	1605DWP52	FD	5/17/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	0.19 J	0.05 U															
WP-54	1605NWP54	N	5/17/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	0.06 U	0.05 U															
WP-57	1605NWP57	N	5/18/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	0.41	0.05 U															
WP-57	1605DWP57	FD	5/18/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	0.44	0.05 U															
WP-65	1605NWP65	N	5/16/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	0.38	0.05 U															
WP-66	1605NWP66	N	5/16/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.35	0.07 U	1.52	0.05 U															
WP-68	1605NWP68	N	5/16/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	0.59	0.05 U															
WP-69	1605DWP69	FD	5/18/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.18 J	0.07 U	1.57	0.05 U															
WP-69	1605NWP69	N	5/18/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.18 J	0.07 U	1.54	0.05 U															0.06 U
WP-71A	1605NWP71A	N	5/18/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	0.18 J	0.05 U															
WP-71B	1605NWP71B	N	5/18/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	0.40	0.05 U															
WP-74	1605NWP74	N	5/18/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.21	0.07 U	1.13	0.05 U															0.06 U
WP-82	1605NWP82	N	5/17/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	0.09 J	0.05 U															

Chemical Name				1,1,1-TCA	1,1-DCA	1,1-DCE	1,2-DCA	cis-1,2-DCE	trans-1,2-DCE	TCE	VC	Ben-zene	Ethyl-benzene	Toluene	m,p-xylene	o-xylene	DRO	GRO	MRO	PFOS	PFOA	PFHpA	PFNA	PFBS	PFHxS	1,4 -dioxane
Analysis Method				EPA Method 524																EPA Method 537						Method 522
CAS RN				71-55-6	75-34-3	75-35-4	107-06-2	156-59-2	156-60-5	79-01-6	75-01-4	71-43-2	100-41-4	108-88-3	179601-23-1	95-47-6	DRO	GRO	MOIL	1763-23-1	335-67-1	375-85-9	375-95-1	375-73-5	355-46-4	123-91-1
MCL				µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Well ID	Sample Name	Sample Type	Sample Date																							
Private Wells with Whole House Filters																										
WP-119 (Influent)	1602NWP119A1	N	2/24/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.16 J	0.10 U	2.92	0.10 U															
WP-119 (Influent)	1605NWP119A1	N	5/17/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.18 J	0.07 U	3.54	0.05 U									0.0400U	0.0200 U	0.0100 U	0.0200 U	0.0900 U	0.0300 U	
WP-119 (Effluent)	1605NWP119C1	N	5/17/2016																	0.0400U	0.0200 U	0.0100 U	0.0200 U	0.0900 U	0.0300 U	
WP-119 (Influent)	1605DWP119A1	FD	5/17/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.18 J	0.07 U	3.76	0.05 U									0.0400U	0.0200 U	0.0100 U	0.0200 U	0.0900 U	0.0300 U	
WP-119 (Influent)	1608NWP119A1	N	8/17/2016	0.20 U	0.20 U	0.20 U	0.20 U	0.17 J	0.20 U	3.57	0.20 U															
WP-119 (Influent)	1611NWP119A1	N	11/16/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.25	0.10 U	3.02	0.10 U															
WP-119 (Mid)	1611NWP119B1	N	11/16/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U															
WP-119 (Effluent)	1611NWP119C1	N	11/16/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U															
WP-121 (Influent)	1602NWP121A1	N	2/24/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.14 J	0.10 U	3.16	0.10 U															
WP-121 (Influent)	1602DWP121A1	FD	2/24/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.12 J	0.10 U	3.32	0.10 U															
WP-121 (Influent)	1605NWP121A1	N	5/17/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.17 J	0.07 U	4.06	0.05 U									0.0400U	0.0200 U	0.0100 U	0.0200 U	0.0900 U	0.00442 J	0.06 U
WP-121 (Effluent)	1605NWP121C1	N	5/17/2016																	0.0400U	0.0200 U	0.0100 U	0.0200 U	0.0900 U	0.0300 U	
WP-121 (Influent)	1608NWP121A1	N	8/17/2016	0.20 U	0.20 U	0.20 U	0.20 U	0.15 J	0.20 U	4.23	0.20 U															
WP-121 (Influent)	1611NWP121A1	N	11/15/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.15 J	0.10 U	3.34	0.10 U															
WP-121 (Mid)	1611NWP121B1	N	11/15/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U															
WP-121 (Effluent)	1611NWP121C1	N	11/15/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U															
WP-123 (Influent)	1602NWP123A1	N	2/24/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.30	0.10 U	2.21	0.10 U															
WP-123 (Influent)	1605NWP123A1	N	5/16/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.26	0.07 U	3.71	0.05 U															
WP-123 (Influent)	1608NWP123A1	N	8/17/2016	0.20 U	0.20 U	0.20 U	0.20 U	0.17 J	0.20 U	3.14	0.20 U															
WP-123 (Influent)	1611NWP123A1	N	11/16/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.49	0.10 U	2.77	0.10 U															
WP-123 (Mid)	1611NWP123B1	N	11/16/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U															
WP-123 (Mid)	1611DWP123B1	FD	11/16/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U															
WP-123 (Effluent)	1611NWP123C1	N	11/16/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U															
WP-124 (Influent)	1602NWP124A1	N	2/24/2016	0.10 U	0.10 U	0.10 U	0.10 U	1.00	0.10 U	3.83	0.10 U															
WP-124 (Influent)	1605NWP124A1	N	5/18/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.88	0.07 U	3.87	0.05 U									0.0400U	0.0200 U	0.0100 U	0.0200 U	0.0900 U	0.0300 U	
WP-124 (Effluent)	1605NWP124C1	N	5/18/2016																	0.0400U	0.0200 U	0.0100 U	0.0200 U	0.0900 U	0.0300 U	
WP-124 (Influent)	1608NWP124A1	N	8/17/2016	0.20 U	0.20 U	0.20 U	0.20 U	0.93	0.20 U	4.03	0.20 U															
WP-124 (Influent)	1611NWP124A1	N	11/15/2016	0.10 U	0.10 U	0.10 U	0.10 U	1.45	0.10 U	4.85	0.10 U															
WP-125 (Influent)	1602NWP125A1	N	2/24/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.76	0.10 U	2.95	0.10 U															
WP-125 (Mid)	1602NWP125B1	N	2/24/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U															
WP-125 (Effluent)	1602NWP125C1	N	2/24/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U															
WP-125 (Influent)	1605NWP125A1	N	5/17/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.92	0.07 U	3.70	0.05 U									0.0400U	0.0200 U	0.0100 U	0.0200 U	0.0900 U	0.0300 U	0.06 U
WP-125 (Mid)	1605NWP125B1	N	5/17/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	0.06 U	0.05 U															
WP-125 (Effluent)	1605NWP125C1	N	5/17/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	0.06 U	0.05 U									0.0400U	0.0200 U	0.0100 U	0.0200 U	0.0900 U	0.0300 U	
WP-125 (Influent)	1608NWP125A1	N	8/17/2016	0.20 U	0.20 U	0.20 U	0.20 U	0.73	0.20 U	3.44	0.20 U															
WP-125 (Influent)	1611NWP125A1	N	11/15/2016	0.10 U	0.10 U	0.10 U	0.10 U	1.02	0.10 U	3.98	0.10 U															
WP-129 (Influent)	1602NWP129A1	N	2/24/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	3.13	0.10 U															
WP-129 (Influent)	1605NWP129A1	N	5/16/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.11 J	0.07 U	3.12	0.05 U															
WP-129 (Influent)	1608NWP129A1	N	8/17/2016	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	1.46	0.20 U															
WP-129 (Influent)	1611NWP129A1	N	11/15/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.11 J	0.10 U	3.39	0.10 U															

APPENDIX B – Comprehensive 2016 Analytical Results

Chemical Name				1,1,1-TCA	1,1-DCA	1,1-DCE	1,2-DCA	cis-1,2-DCE	trans-1,2-DCE	TCE	VC	Ben-zene	Ethyl-benzene	Toluene	m,p-xylene	o-xylene	DRO	GRO	MRO	PFOS	PFOA	PFHpA	PFNA	PFBS	PFHxS	1,4 -dioxane
Analysis Method				EPA Method 524																EPA Method 537						Method 522
CAS RN				71-55-6	75-34-3	75-35-4	107-06-2	156-59-2	156-60-5	79-01-6	75-01-4	71-43-2	100-41-4	108-88-3	179601-23-1	95-47-6	DRO	GRO	MOIL	1763-23-1	335-67-1	375-85-9	375-95-1	375-73-5	355-46-4	123-91-1
MCL				µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Well ID	Sample Name	Sample Type	Sample Date																							
WP-14 (Influent)	1602NWP14A1	N	2/23/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.71	0.10 U	2.85	0.10 U															
WP-14 (Influent)	1605NWP14A1	N	5/18/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.85	0.07 U	3.22	0.05 U															
WP-14 (Mid)	1605NWP14B1	N	5/18/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	0.06 U	0.05 U															
WP-14 (Effluent)	1605NWP14C1	N	5/18/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	0.06 U	0.05 U															
WP-14 (Influent)	1608NWP14A1	N	8/17/2016	0.20 U	0.20 U	0.20 U	0.20 U	0.85	0.20 U	3.14	0.20 U															
WP-14 (Influent)	1608DWP14A1	FD	8/17/2016	0.20 U	0.20 U	0.20 U	0.20 U	0.92	0.20 U	3.45	0.20 U															
WP-14 (Influent)	1611NWP14A1	N	11/16/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.89	0.10 U	3.11	0.10 U															
WP-70 (Influent)	1602NWP70A1	N	2/24/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.19 J	0.10 U	3.06	0.10 U															
WP-70 (Influent)	1605NWP70A1	N	5/16/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.23	0.07 U	2.98	0.05 U															
WP-70 (Mid)	1605NWP70B1	N	5/16/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	0.06 U	0.05 U															
WP-70 (Effluent)	1605NWP70C1	N	5/16/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	0.06 U	0.05 U															
WP-70 (Influent)	1608NWP70A1	N	8/17/2016	0.20 U	0.20 U	0.20 U	0.20 U	0.20 J	0.20 U	3.66	0.20 U															
WP-70 (Influent)	1608DWP70A1	FD	8/17/2016	0.20 U	0.20 U	0.20 U	0.20 U	0.23	0.20 U	3.89	0.20 U															
WP-70 (Influent)	1611NWP70A1	N	11/15/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.29	0.10 U	3.52	0.10 U															
WP-83 (Influent)	1602NWP83A1	N	2/23/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.24	0.10 U	1.28	0.10 U															
WP-83 (Influent)	1605NWP83A1	N	5/17/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.23	0.07 U	1.05	0.05 U															
WP-83 (Mid)	1605NWP83B1	N	5/17/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	0.06 U	0.05 U															
WP-83 (Effluent)	1605NWP83C1	N	5/17/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	0.06 U	0.05 U															
WP-83 (Influent)	1608NWP83A1	N	8/17/2016	0.20 U	0.20 U	0.20 U	0.20 U	0.22	0.20 U	1.05	0.20 U															
WP-83 (Influent)	1611NWP83A1	N	11/16/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.29	0.10 U	1.12	0.10 U															
WP-86 (Influent)	1602NWP86A1	N	2/23/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	2.31	0.10 U															
WP-86 (Influent)	1605NWP86A1	N	5/17/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	2.13	0.05 U															
WP-86 (Mid)	1605NWP86B1	N	5/17/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	0.06 U	0.05 U															
WP-86 (Effluent)	1605NWP86C1	N	5/17/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	0.06 U	0.05 U															
WP-86 (Influent)	1608NWP86A1	N	8/17/2016	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	1.03	0.20 U															
WP-86 (Influent)	1611NWP86A1	N	11/16/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	2.07	0.10 U															
Quality Control Samples																										
	1602TB01	TB	2/23/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U															
	1602TB03	TB	2/23/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U															
	1602TB04	TB	2/24/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U															
	1602TB05	TB	2/24/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U															
	1602PDTB01	TB	2/24/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U															
	1602TB02	TB	2/24/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U															
	1602PDTB02	TB	2/24/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U															
	1605TB10	TB	5/16/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	0.06 U	0.05 U															
	1605TB14	TB	5/16/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	0.06 U	0.05 U															
	1605TB01	TB	5/16/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	0.06 U	0.05 U	0.03 U	0.04 U	0.04 U	0.05 U	0.04 U		9.06 U								
	1605TB11	TB	5/16/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	0.06 U	0.05 U															
	1605TB02	TB	5/17/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	0.06 U	0.05 U	0.03 U	0.04 U	0.04 U	0.05 U	0.04 U		9.06 U								
	1605TB12	TB	5/18/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	0.06 U	0.05 U															
	1605TB16	TB	5/18/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	0.06 U	0.05 U															

APPENDIX B – Comprehensive 2016 Analytical Results

Chemical Name				1,1,1-TCA	1,1-DCA	1,1-DCE	1,2-DCA	cis-1,2-DCE	trans-1,2-DCE	TCE	VC	Ben-zene	Ethyl-benzene	Toluene	m,p-xylene	o-xylene	DRO	GRO	MRO	PFOS	PFOA	PFHpA	PFNA	PFBS	PFHxS	1,4 -dioxane
Analysis Method				EPA Method 524																EPA Method 537						Method 522
CAS RN				71-55-6	75-34-3	75-35-4	107-06-2	156-59-2	156-60-5	79-01-6	75-01-4	71-43-2	100-41-4	108-88-3	179601-23-1	95-47-6	DRO	GRO	MOIL	1763-23-1	335-67-1	375-85-9	375-95-1	375-73-5	355-46-4	123-91-1
MCL				µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Well ID	Sample Name	Sample Type	Sample Date																							
Collected at WP-156	1605EBJWBC	EB	5/18/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	0.06 U	0.05 U															
	1605TB03	TB	5/19/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	0.09 J	0.05 U															
	1605TB04	TB	5/19/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	0.06 U	0.05 U															
	1605TB05	TB	5/20/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	0.06 U	0.05 U															
	1605TB06	TB	5/20/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	0.06 U	0.05 U															
	1605TB07	TB	5/20/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	0.06 U	0.05 U															
	1605TB08	TB	5/20/2016	0.04 U	0.07 U	0.06 U	0.07 U	0.10 U	0.07 U	0.06 U	0.05 U															
	1608TB01	TB	8/16/2016	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U															
	1608PDTB01	TB	8/18/2016	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U															
	1611TB03	TB	11/14/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U															
	1611TB04	TB	11/14/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.06 J	0.10 U															
	1611TB05	TB	11/14/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U															
	1611TB01	TB	11/15/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U															
	1611TB02	TB	11/15/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U															
	1611PDTB01	TB	11/16/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.08 J	0.10 U															
Collected at 04CW07	1611FBMW01	FB	11/17/2016	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U															
Collected at WP-83	1608FBWP83	FB	8/17/2016	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U															

1,1,1-TCA	1,1,1-Trichloroethane
1,1-DCA	1,1-Dichloroethane
1,1-DCE	1,1-Dichloroethene
1,2-DCA	1,2-Dichloroethane
CIS-1,2-DCE	Cis-1,2-Dichloroethene
TRANS-1,2-DCE	Trans-1,2-Dichloroethene
TCE	Trichloroethene
VC	Vinyl Chloride
DRO	Diesel Range Organics
GRO	Gasoline Range Organics
MRO	Motor Oils
PFOS	Perfluorooctanesulfonic Acid (PFOS)
PFOA	Perfluorooctanoic Acid (PFOA)
PFHpA	Perfluoroheptanoic Acid
PFNA	Perfluorononanoic Acid (PFNA)
PFBS	Perfluorobutanesulfonic Acid (PFBS)
PFHxS	Perfluorohexanesulfonic Acid (PFHxS)

APPENDIX C – 2016 Whole House Filter Efficiency Memorandum

U.S. ARMY CORPS of ENGINEERS
Seattle District

Environmental Engineering and Technology Section,
Technical Services Branch, Engineering Division

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MEMORANDUM

DATE: 7 June 2016

FROM: Karah Haskins – Technical Project Lead, USACE Seattle District

TO: Rod Lobos - Moses Lake RPM, Region 10

SUBJECT: Moses Lake Whole House Filter Efficiency Evaluation

The purpose of this memorandum (memo) is to evaluate results for Siemens AWC-1230 Whole House Filter (WHF) systems installed in September 2014 and April 2015 at Moses Lake residential wells WP-123 and WP-125. This memo evaluates whether the filters worked sufficiently for a year after installation to protect residents from exposure to trichloroethene (TCE) greater than the Maximum Contaminant Level (MCL), which is 5 µg/L. In addition, this memo evaluates whether there is sufficient evidence to support the reduction in filter sampling frequency from quarterly sampling.

WHF systems are installed at private wells when TCE concentrations are greater than or equal to 3.5 µg/L TCE. More information on the WHF systems can be found in Appendix A of the 2015 Work Plan. The granular activated carbon (GAC) in the WHF vessels is replaced annually to compensate for performance reduction due to dissolved solids, iron, biofilm, and adsorption of other organic constituents. Annual change-out also protects against buildup of nitrates in the system, which can be transformed to toxic nitrites under certain conditions. The validity of conclusions stated in this report are limited to the observed flow and contaminant concentration ranges discussed herein and the assumption that WHF GAC will be replaced annually.

The following is a summary of the actions taken at WP-123 and WP-125:

- **<u>WP-123:</u>** All three sampling ports were sampled during five sampling events after the WHF was installed at WP-123 in September 2014. The GAC filters were replaced over a year later during the November 2015 event; however, the absence of detectable concentrations in the mid and effluent ports during the five sampling events (October 2014 to November 2015) indicate that the filters were protective of human health.

- **<u>WP-125:</u>** All three sampling ports were sampled during four sampling events at WP-125 (May 2015 through February 2016).

Flow rates were calculated using flow meter readings recorded at the time of quarterly sampling and are presented in **Table 1**. The average flow rates were 477 and 1051 gallons per day for WP-123 and WP-125, respectively. Detected concentrations of TCE and cis-dichloroethene (cis-DCE) collected at the lead sample port (influent) are also summarized in **Table 1.**

Overall, the WHFs are working sufficiently to ensure protection of human health. There were no detections of TCE or cis-DCE in the mid or effluent ports. The average flow rates and the TCE concentrations were similar to those observed during the WHF efficiency evaluation for WP-14, 70, 83, and 86 (summarized in a prior WHF efficiency analysis memo dated September 23, 2014) and WP-119, WP-121, WP-124, and WP-129 (summarized in a prior WHF efficiency analysis memo dated July 14, 2015). This evidence suggests that the WHFs are working sufficiently to protect human health at the current amount of TCE mass loading and volume of flow through the filters.

The technical team recommends continuing to sample the WHF influent ports quarterly at WP-123 and 125 to evaluate seasonal trends. However, the results of this memo conclude that the sampling frequency for the mid and effluent ports can be reduced to annual sampling and still protect human health based on the current flow rates, TCE concentrations, and assumption of annual replacement of WHFs.

Appendix C

Table 1. Moses Lake WHF Systems - Flow Meter Readings and Detected Analytes

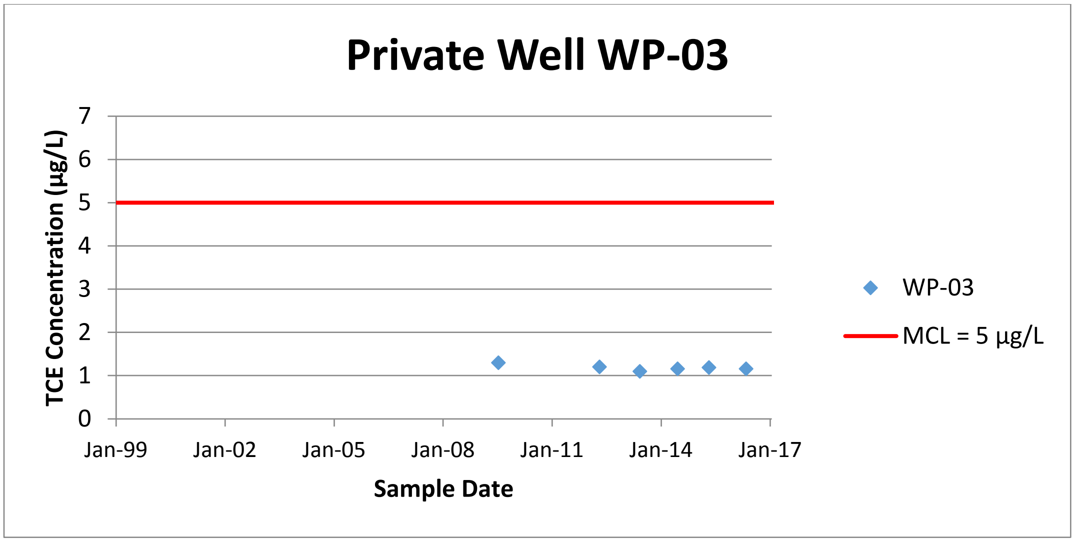
Well ID	Date	Event	Flow Meter Reading (gal)	Quarterly Flow Rate (gal/day)	Lead Influent TCE µg/L	Lead Influent CIS-DCE µg/L	Mid/Effluent Detect?
WP-123	10/2/2014	end of Q1	6,425	428	3.71	0.18	N
	11/20/2014	end of Q2	14,898	173	2.7	0.31	N
	2/26/2015	end of Q3	22,565	78	2.57	0.43	N
	5/7/2015	end of Q4	35,632	187	2.77	0.25	N
	8/1/2015	end of Q5	151,681	1,349	2.21		N
			avg flow	*477*	gal/day		
				151,681	gal/yr		

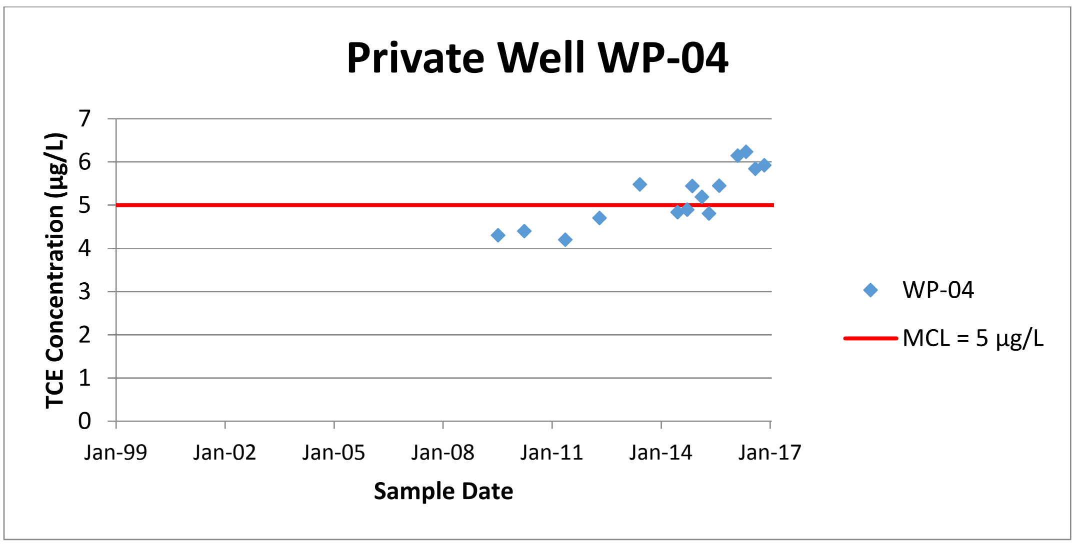
Well ID	Date	Event	Flow Meter Reading (gal)	Quarterly Flow Rate (gal/day)	Lead Influent TCE µg/L	Lead Influent CIS-DCE µg/L	Mid/Effluent Detect?
WP-125	5/7/2015	end of Q1	15,596	678	2.68	0.62	N
	8/18/2015	end of Q2	85,420	678	2.85	0.57	N
	11/17/2015	end of Q3	198,065	1,238	3.72	1.02	N
	2/24/2016	end of Q4	332,053	1,353	2.95	0.76	N
			avg flow	*1,051*	gal/day		
				332,053	gal/yr		

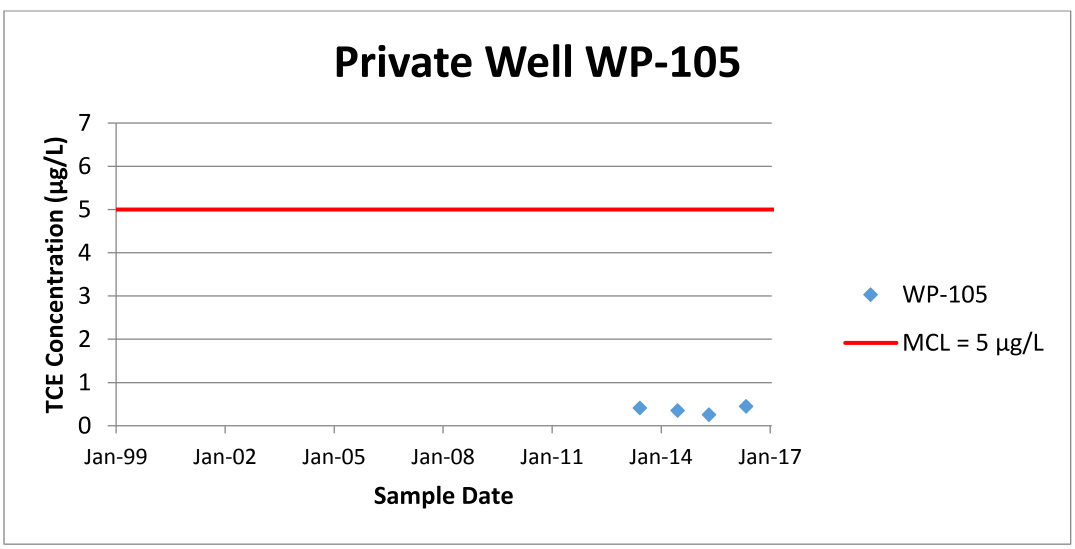
1 - Systems were installed in September 2014 (WP-123) and April 2015 (WP-125), which = time 0.

APPENDIX D – TCE Time-Series Graphs

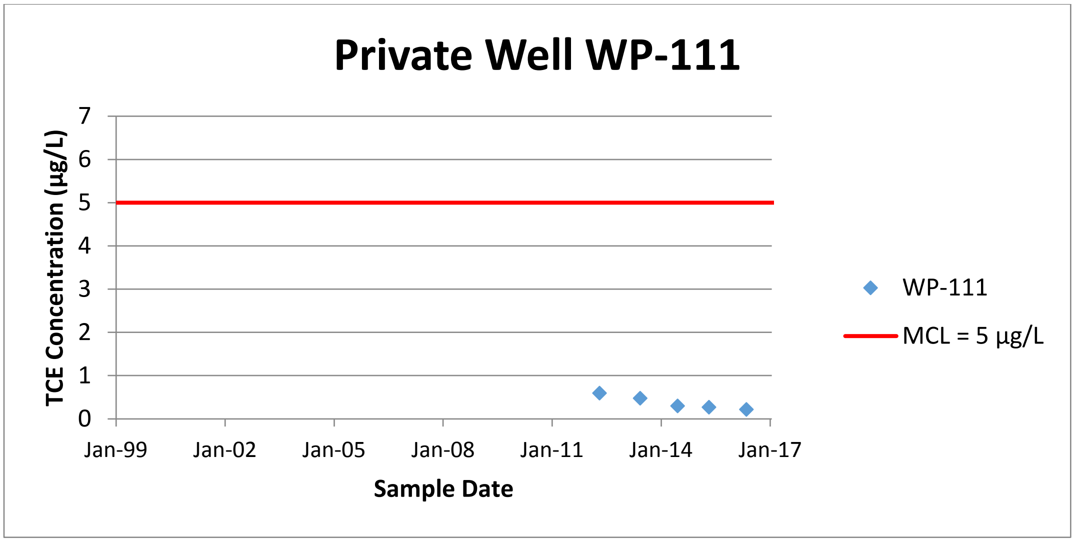
Appendix D - Private Wells

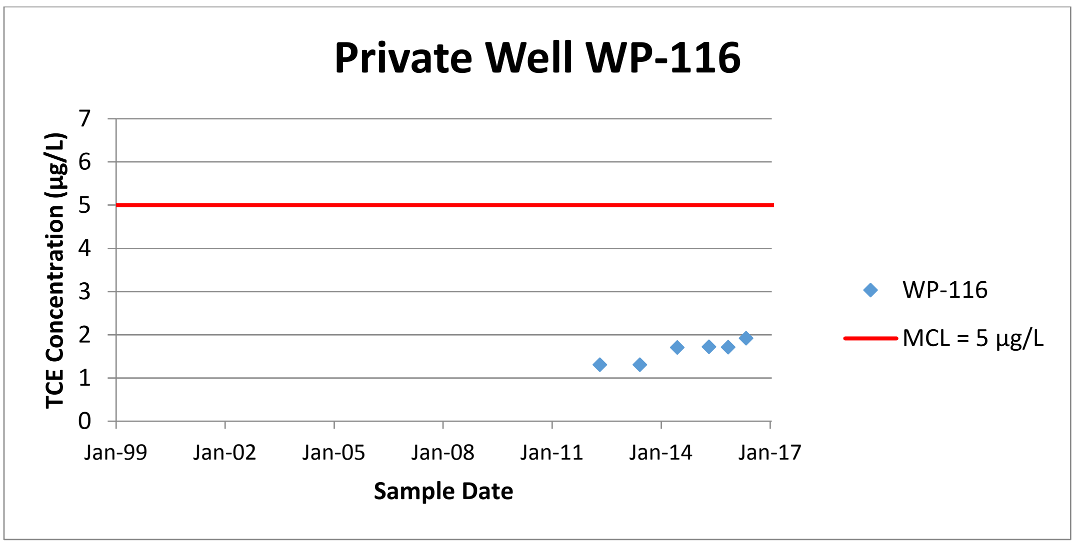


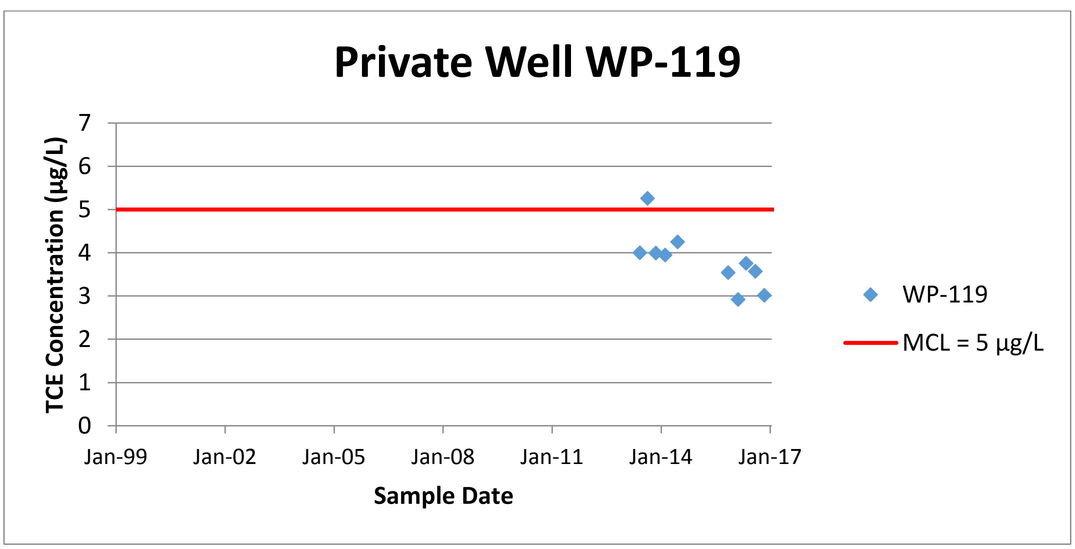


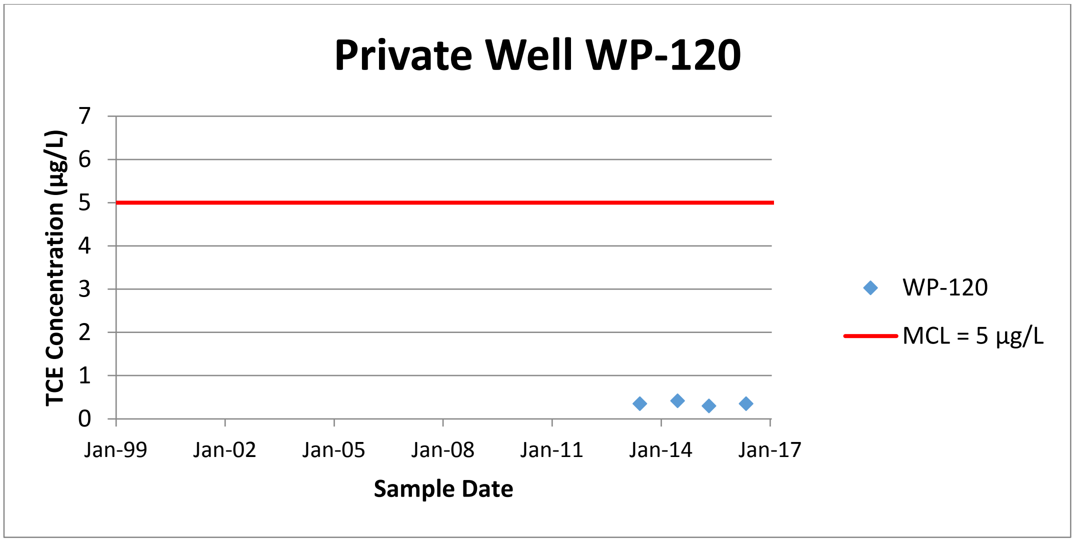


Appendix D - Private Wells

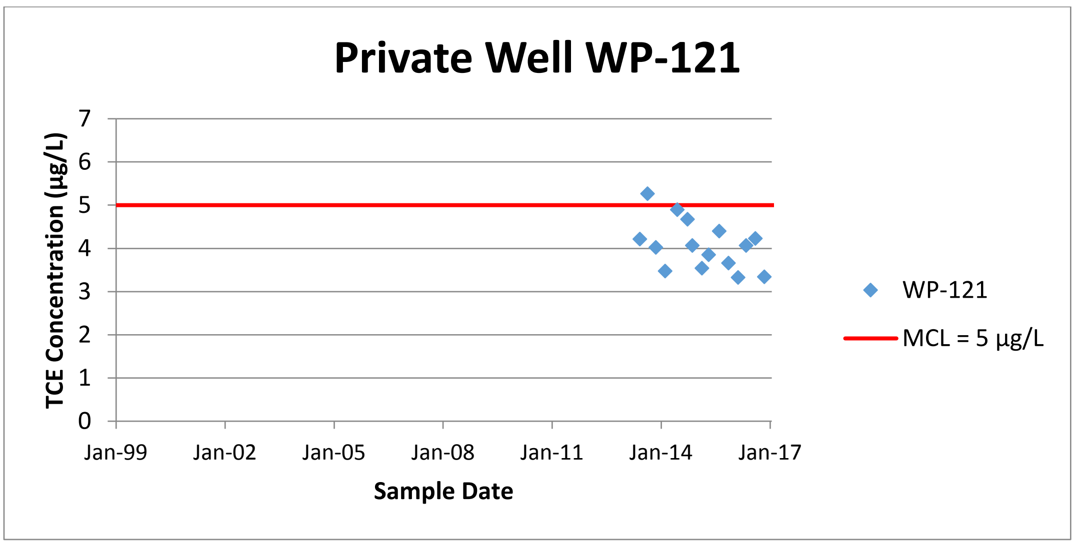




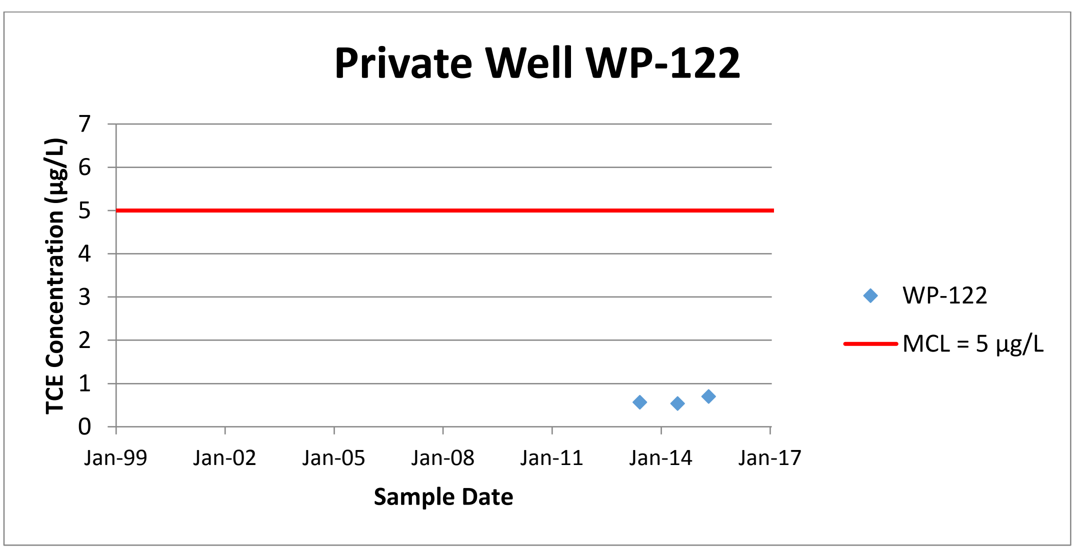




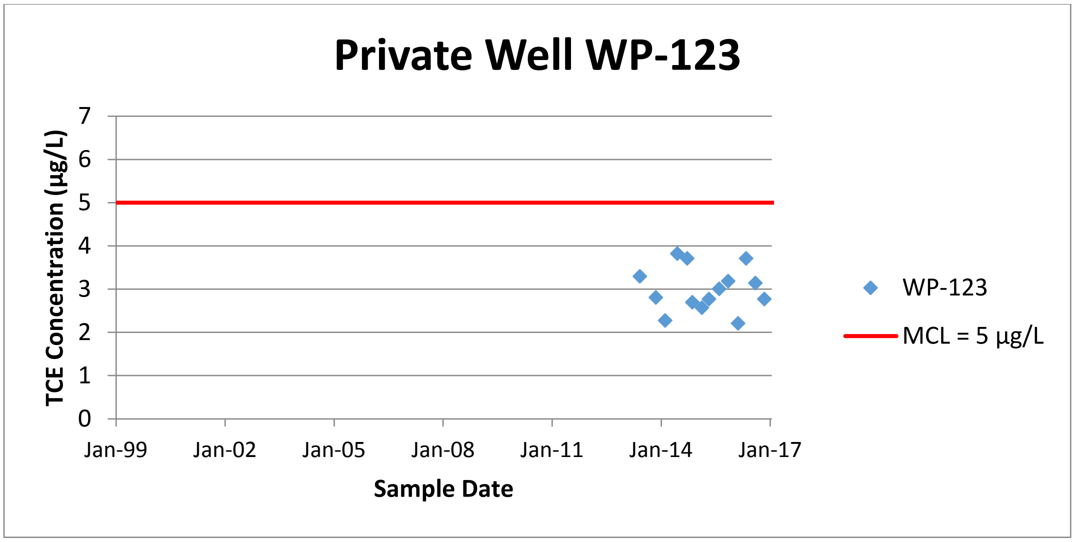
Private Well WP-120
TCE Concentration (µg/L)
0
1
2
3
4
5
6
7
Jan-99
Jan-02
Jan-05
Jan-08
Jan-11
Jan-14
Jan-17
Sample Date
WP-120
MCL = 5 µg/L

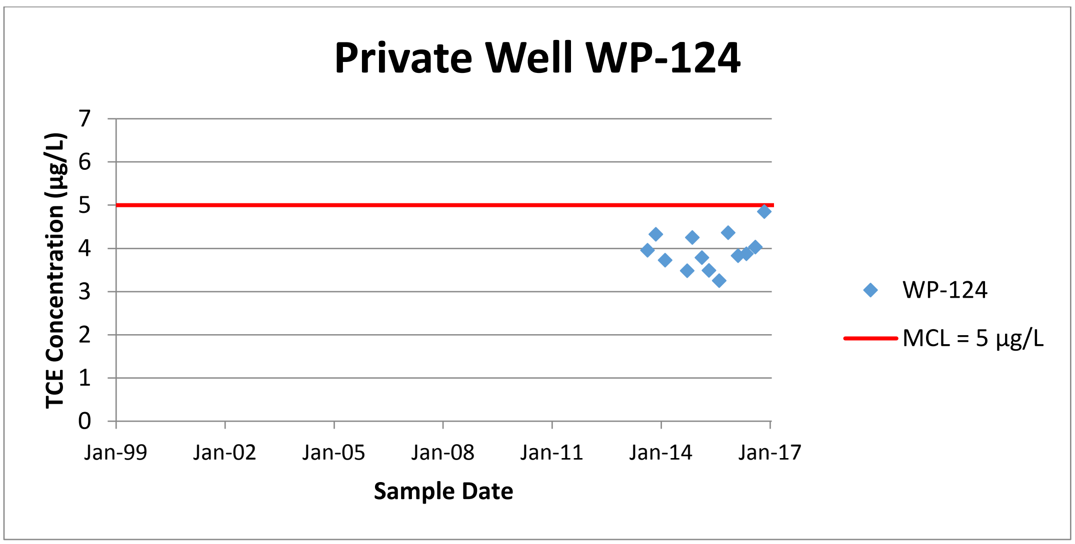


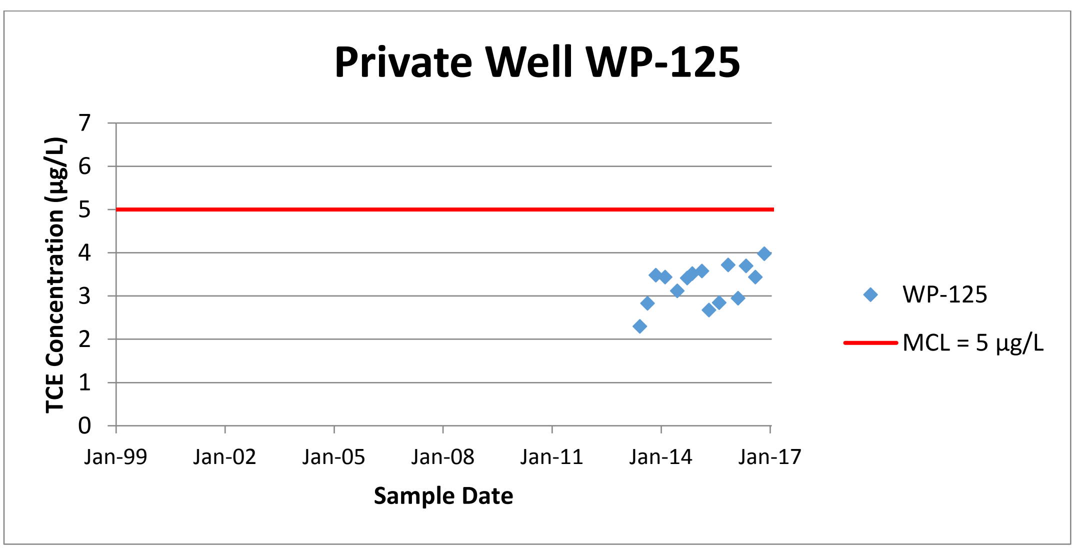
Private Well WP-121
TCE Concentration (µg/L)
0
1
2
3
4
5
6
7
Jan-99
Jan-02
Jan-05
Jan-08
Jan-11
Jan-14
Jan-17
Sample Date
WP-121
MCL = 5 µg/L

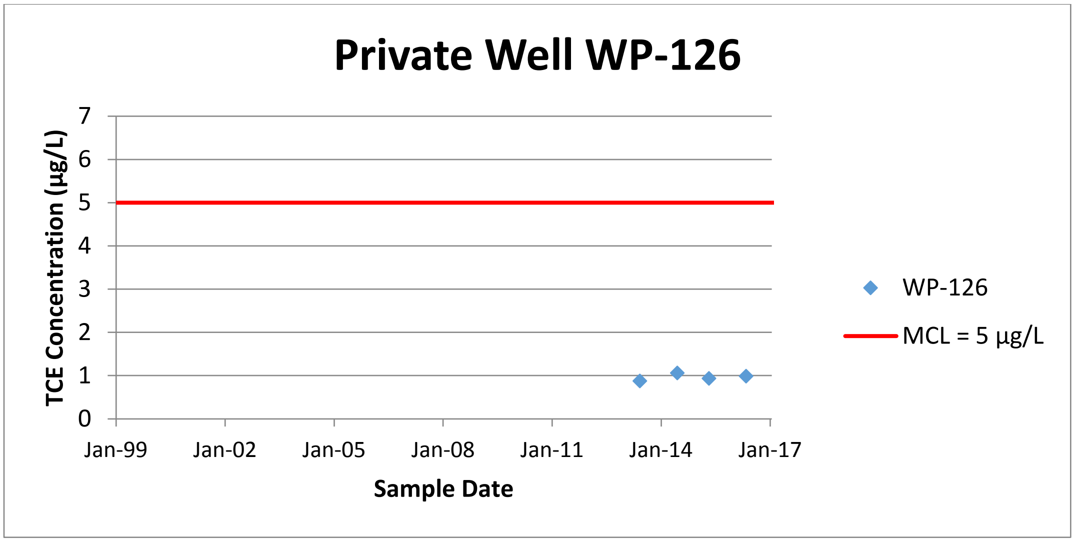


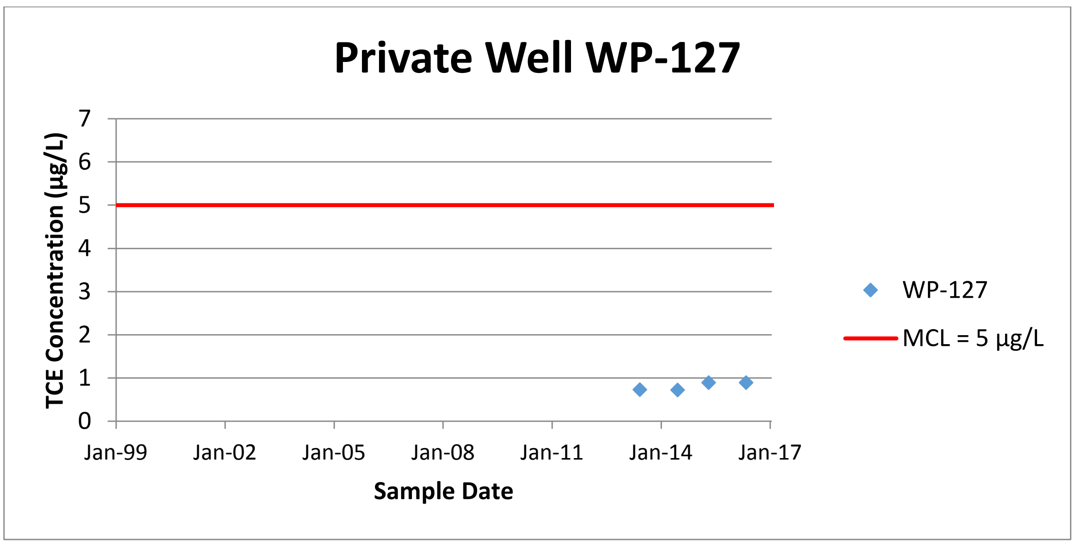
Private Well WP-122
TCE Concentration (µg/L)
0
1
2
3
4
5
6
7
Jan-99
Jan-02
Jan-05
Jan-08
Jan-11
Jan-14
Jan-17
Sample Date
WP-122
MCL = 5 µg/L

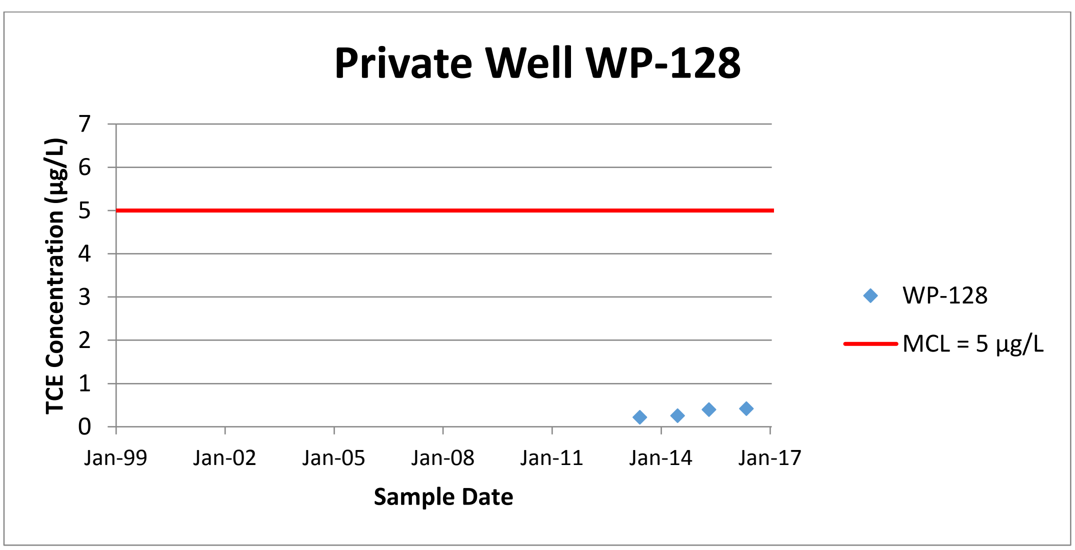

Private Well WP-123
TCE Concentration (µg/L)
0
1
2
3
4
5
6
7
Jan-99
Jan-02
Jan-05
Jan-08
Jan-11
Jan-14
Jan-17
Sample Date
WP-123
MCL = 5 µg/L

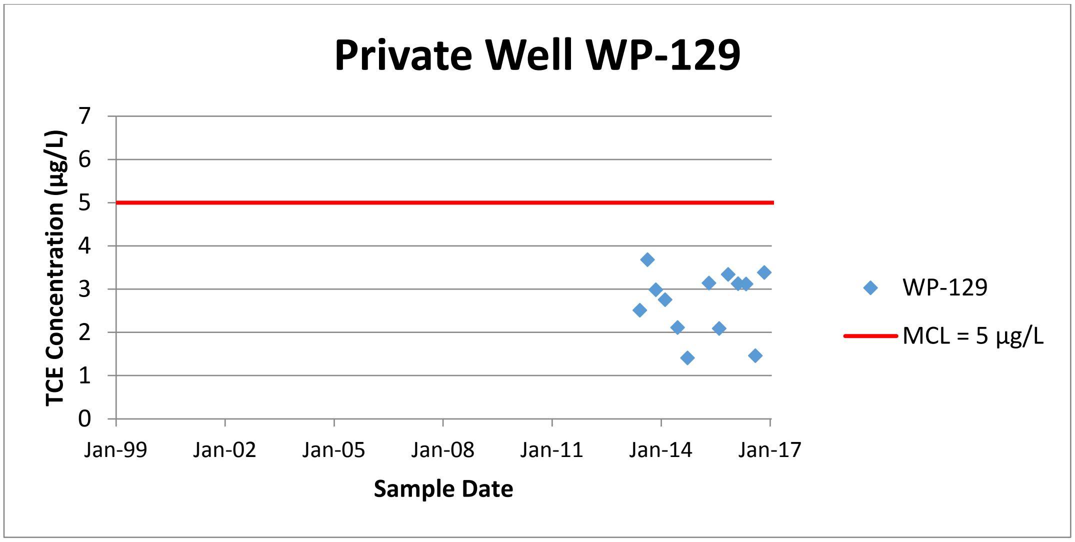

Private Well WP-124
TCE Concentration (µg/L)
0
1
2
3
4
5
6
7
Jan-99
Jan-02
Jan-05
Jan-08
Jan-11
Jan-14
Jan-17
Sample Date
WP-124
MCL = 5 µg/L

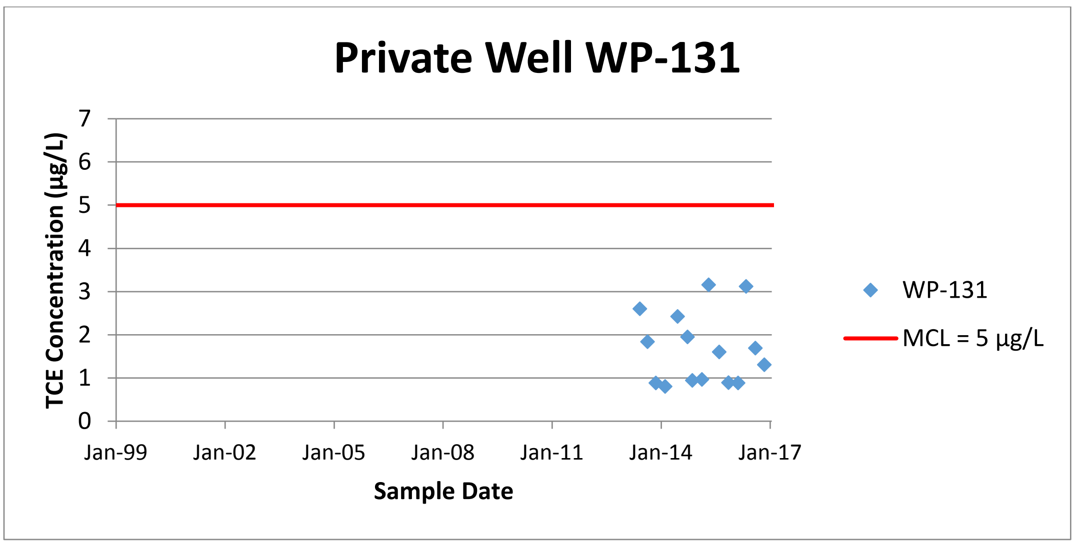

Private Well WP-125
TCE Concentration (µg/L)
0
1
2
3
4
5
6
7
Jan-99
Jan-02
Jan-05
Jan-08
Jan-11
Jan-14
Jan-17
Sample Date
WP-125
MCL = 5 µg/L

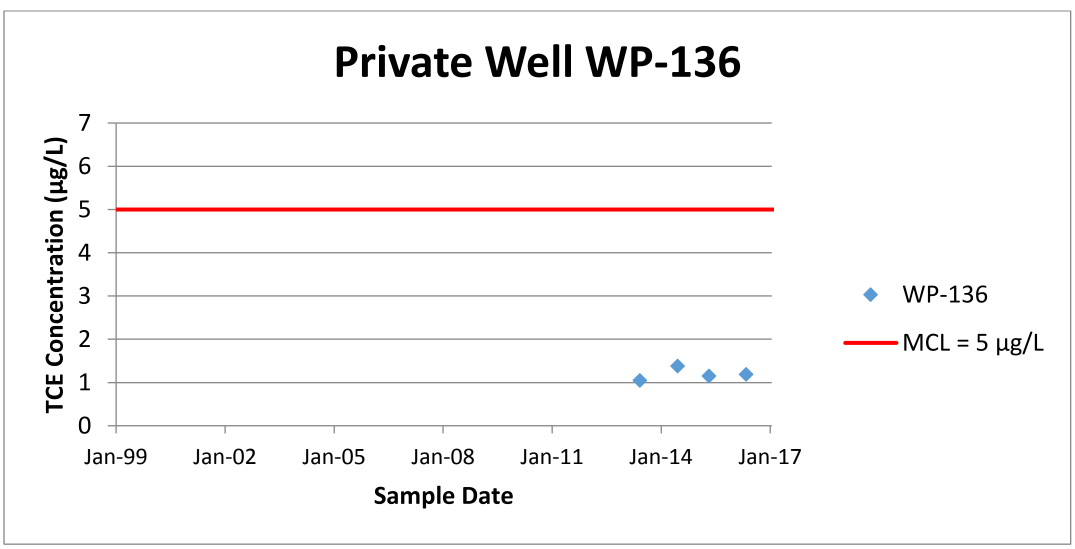

Private Well WP-126
TCE Concentration (µg/L)
7
6
5
4
3
2
1
0
Jan-99
Jan-02
Jan-05
Jan-08
Jan-11
Jan-14
Jan-17
Sample Date
WP-126
MCL = 5 µg/L

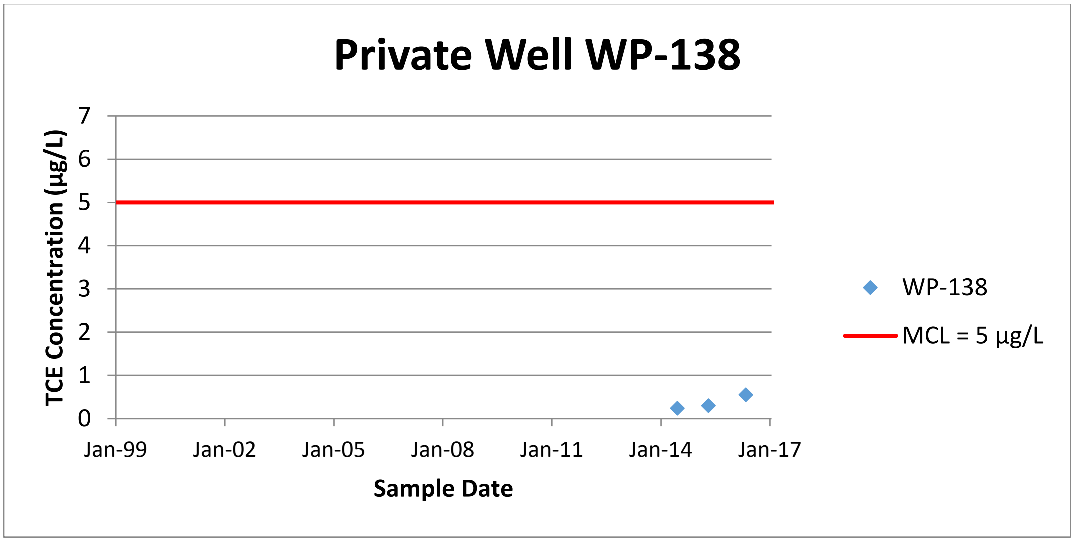

Private Well WP-127
TCE Concentration (µg/L)
7
6
5
4
3
2
1
0
Jan-99
Jan-02
Jan-05
Jan-08
Jan-11
Jan-14
Jan-17
Sample Date
WP-127
MCL = 5 µg/L

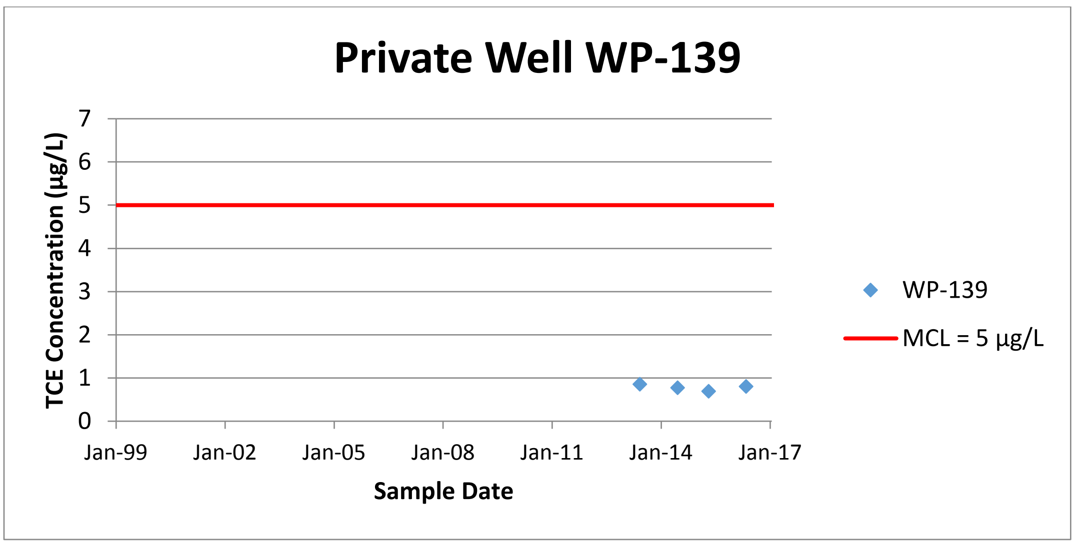

Private Well WP-128
TCE Concentration (µg/L)
7
6
5
4
3
2
1
0
Jan-99
Jan-02
Jan-05
Jan-08
Jan-11
Jan-14
Jan-17
Sample Date
WP-128
MCL = 5 µg/L

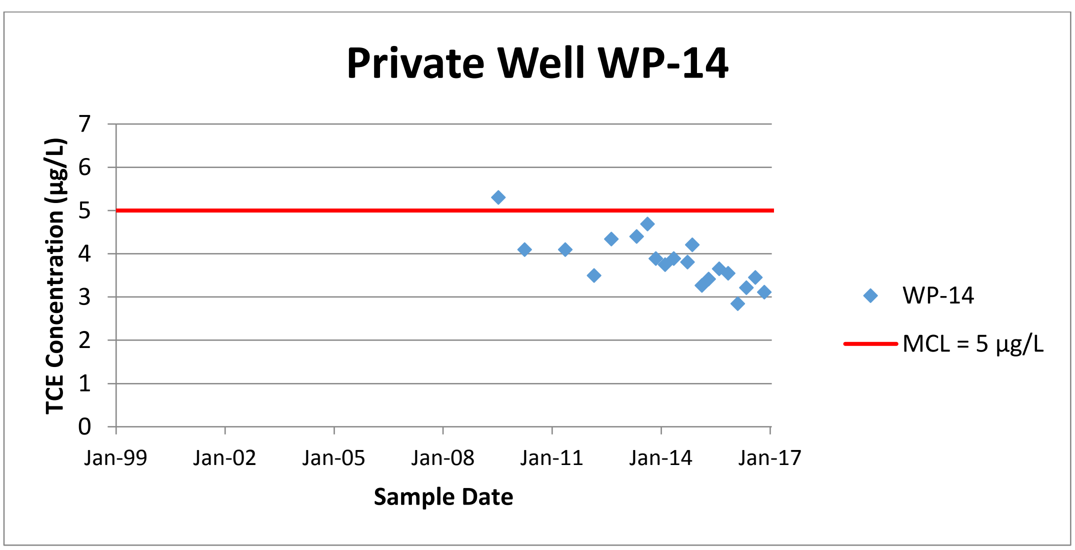

Private Well WP-129
TCE Concentration (µg/L)
7
6
5
4
3
2
1
0
Jan-99
Jan-02
Jan-05
Jan-08
Jan-11
Jan-14
Jan-17
Sample Date
WP-129
MCL = 5 µg/L

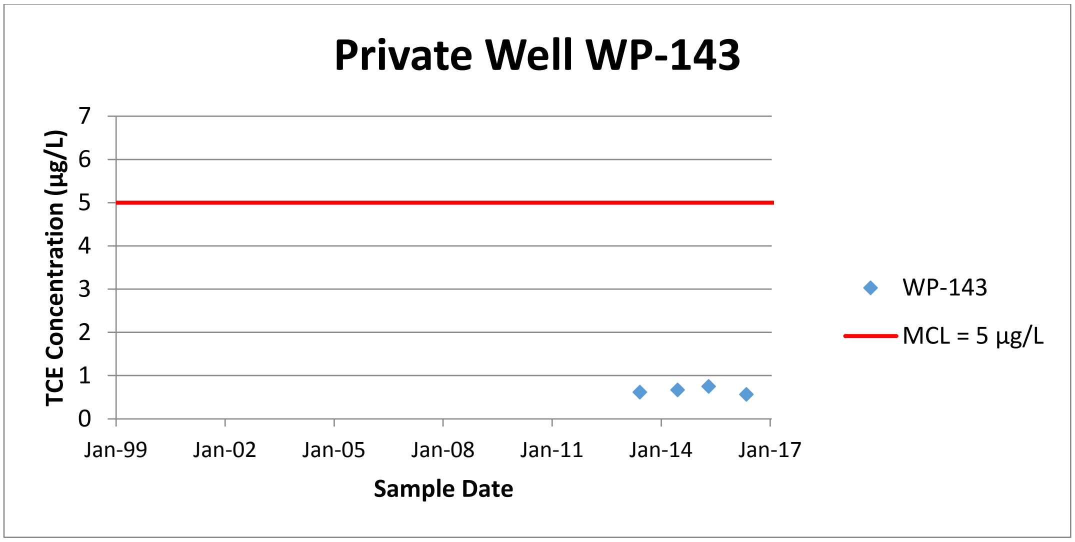

Private Well WP-131
TCE Concentration (µg/L)
7
6
5
4
3
2
1
0
Jan-99
Jan-02
Jan-05
Jan-08
Jan-11
Jan-14
Jan-17
Sample Date
WP-131
MCL = 5 µg/L

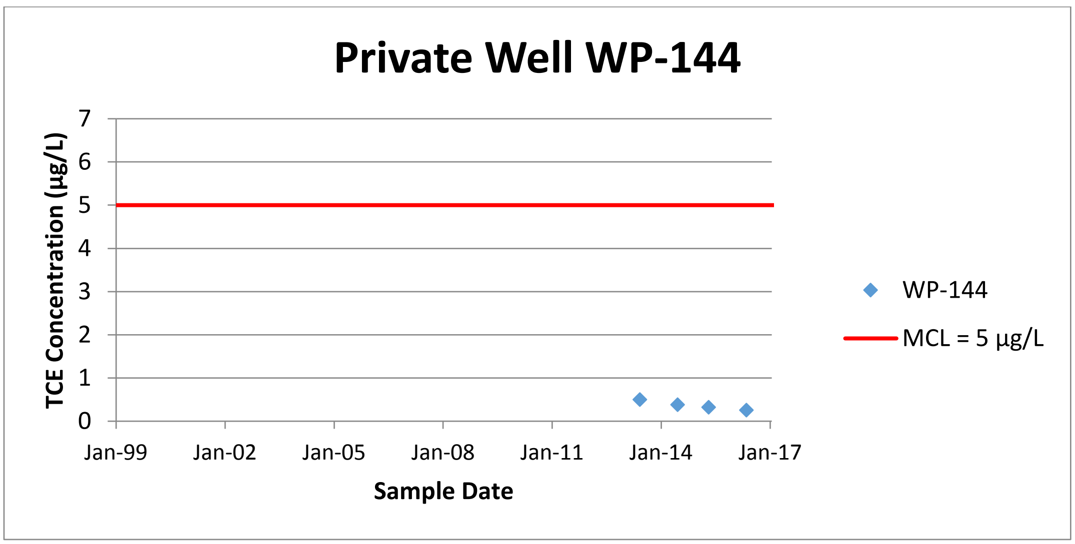

Private Well WP-136
TCE Concentration (µg/L)
7
6
5
4
3
2
1
0
Jan-99
Jan-02
Jan-05
Jan-08
Jan-11
Jan-14
Jan-17
Sample Date
WP-136
MCL = 5 µg/L

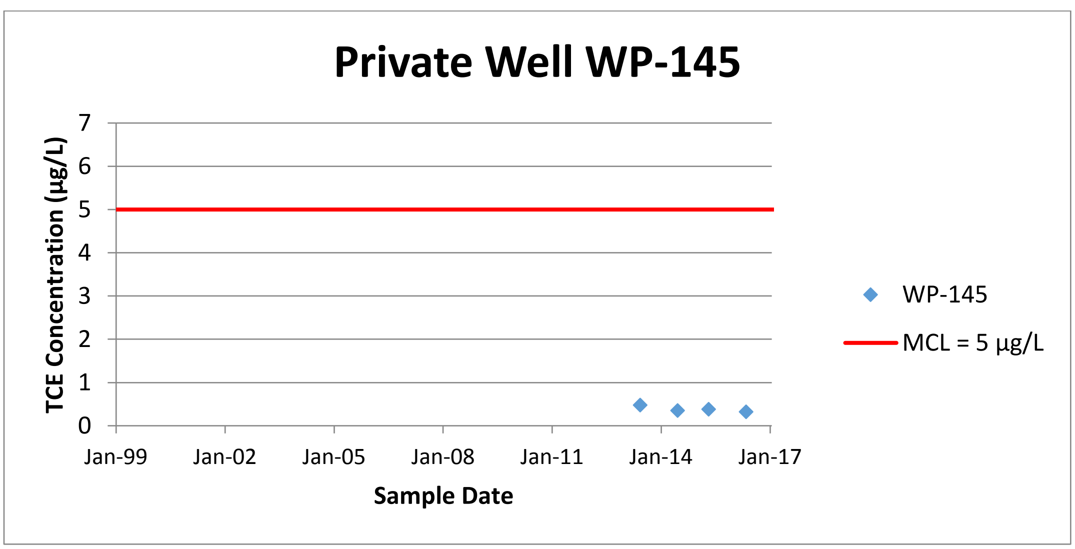

Private Well WP-138
TCE Concentration (µg/L)
7
6
5
4
3
2
1
0
Jan-99
Jan-02
Jan-05
Jan-08
Jan-11
Jan-14
Jan-17
Sample Date
WP-138
MCL = 5 µg/L

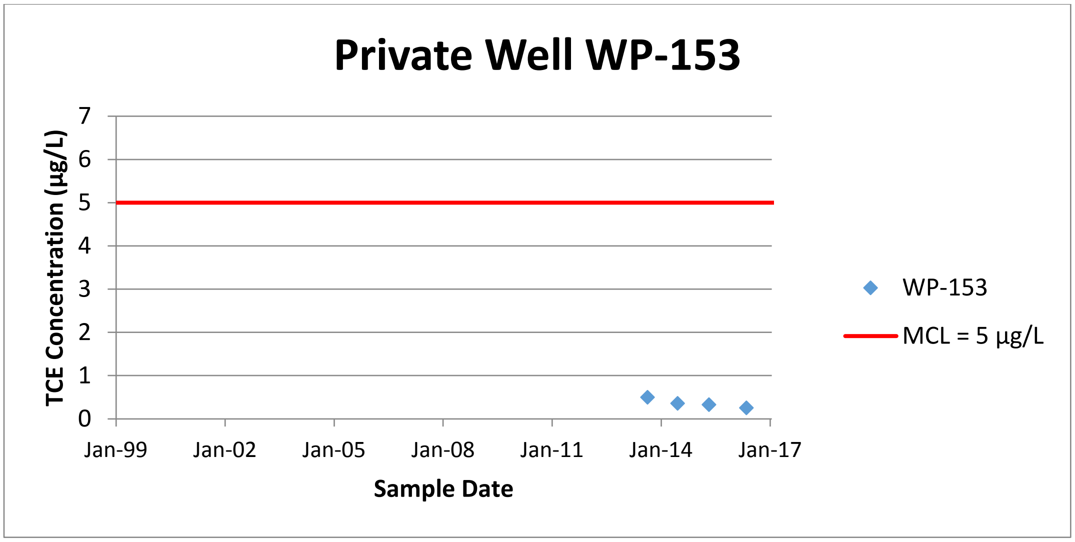

Private Well WP-139
TCE Concentration (µg/L)
7
6
5
4
3
2
1
0
Jan-99
Jan-02
Jan-05
Jan-08
Jan-11
Jan-14
Jan-17
Sample Date
WP-139
MCL = 5 µg/L

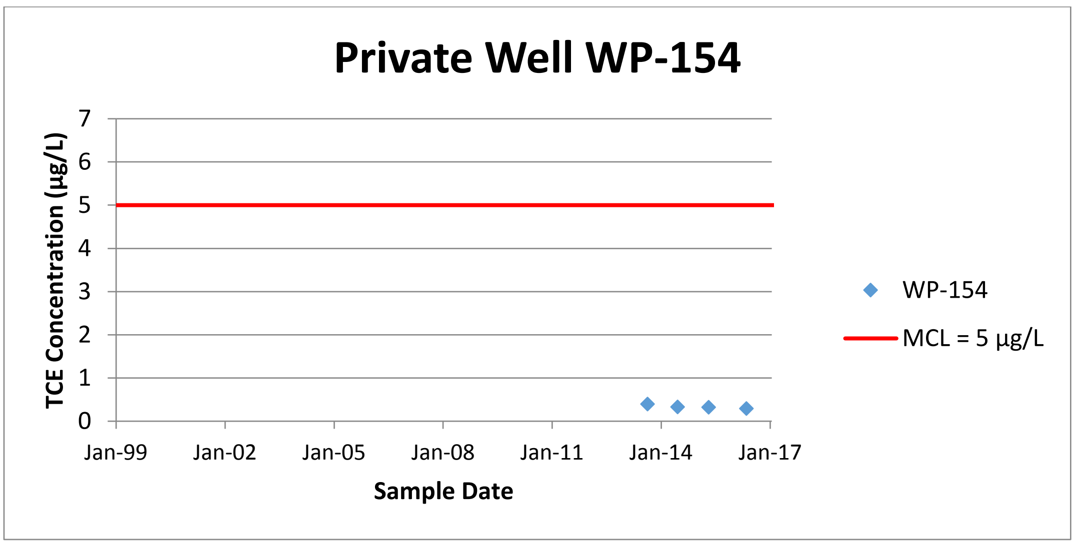

Private Well WP-14
TCE Concentration (µg/L)
7
6
5
4
3
2
1
0
Jan-99
Jan-02
Jan-05
Jan-08
Jan-11
Jan-14
Jan-17
Sample Date
WP-14
MCL = 5 µg/L

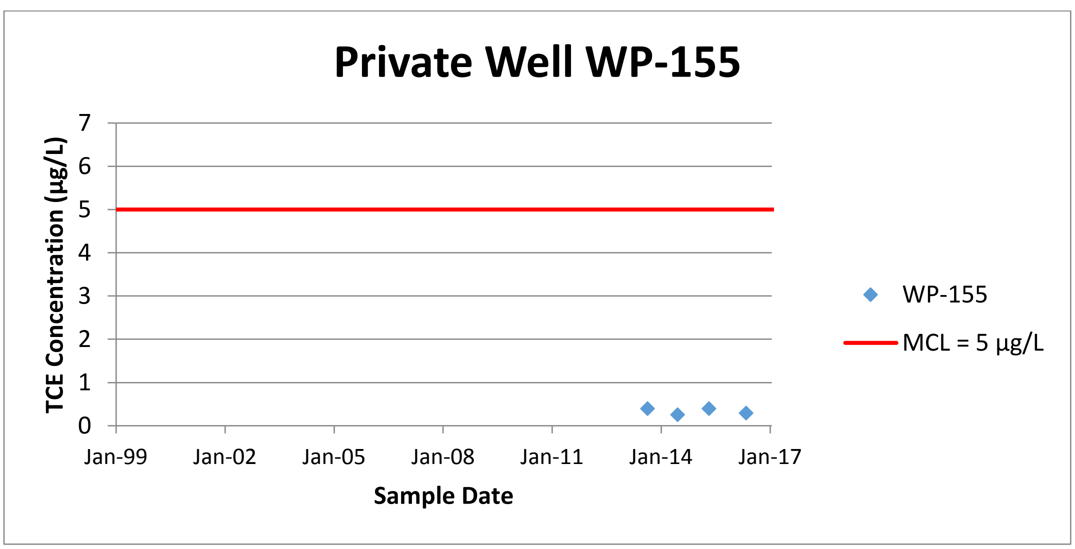

Private Well WP-143
TCE Concentration (µg/L)
7
6
5
4
3
2
1
0
Jan-99
Jan-02
Jan-05
Jan-08
Jan-11
Jan-14
Jan-17
Sample Date
WP-143
MCL = 5 µg/L

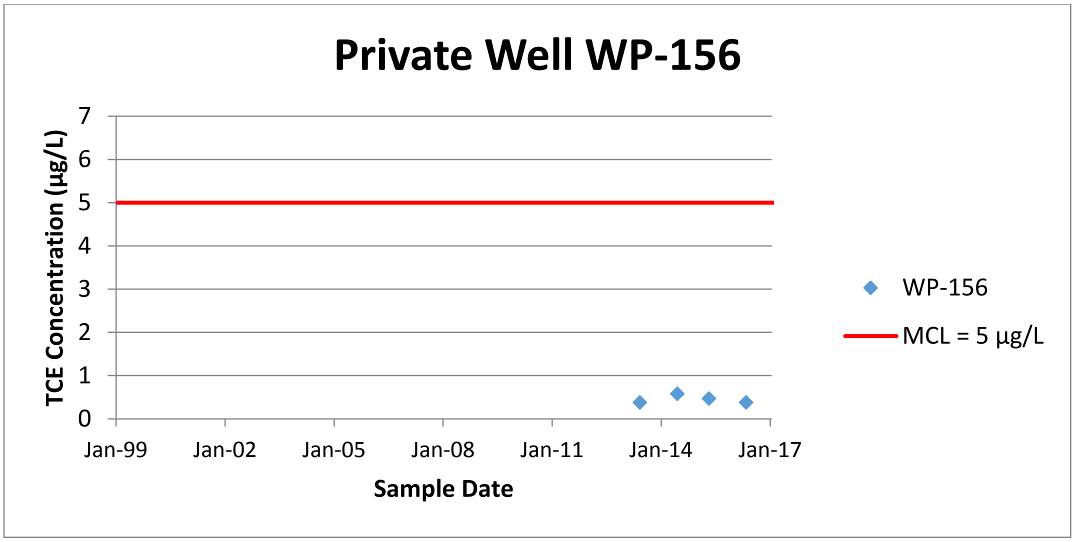

Private Well WP-144
TCE Concentration (µg/L)
7
6
5
4
3
2
1
0
Jan-99
Jan-02
Jan-05
Jan-08
Jan-11
Jan-14
Jan-17
Sample Date
WP-144
MCL = 5 µg/L

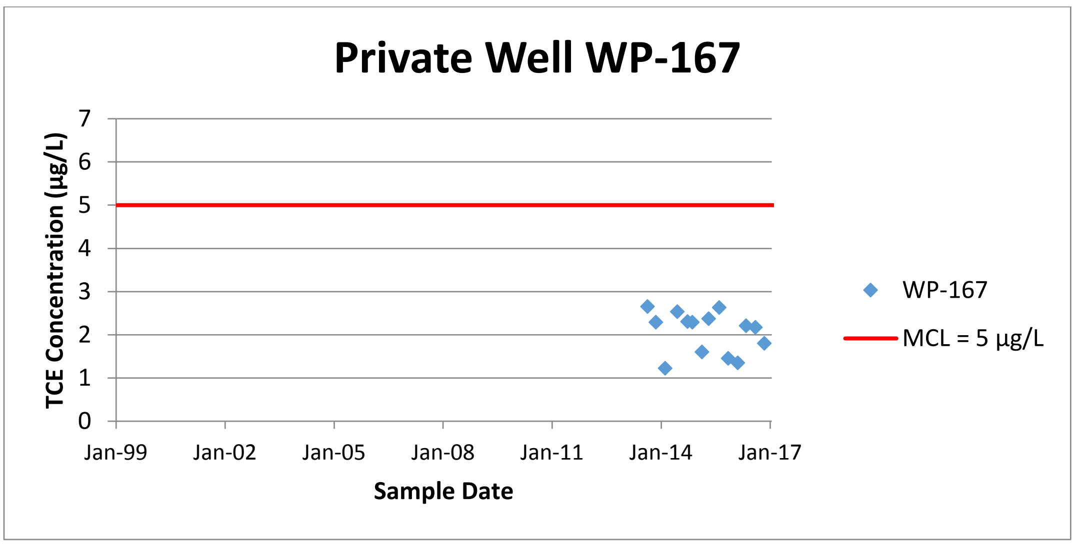

Private Well WP-145
TCE Concentration (µg/L)
7
6
5
4
3
2
1
0
Jan-99
Jan-02
Jan-05
Jan-08
Jan-11
Jan-14
Jan-17
Sample Date
WP-145
MCL = 5 µg/L

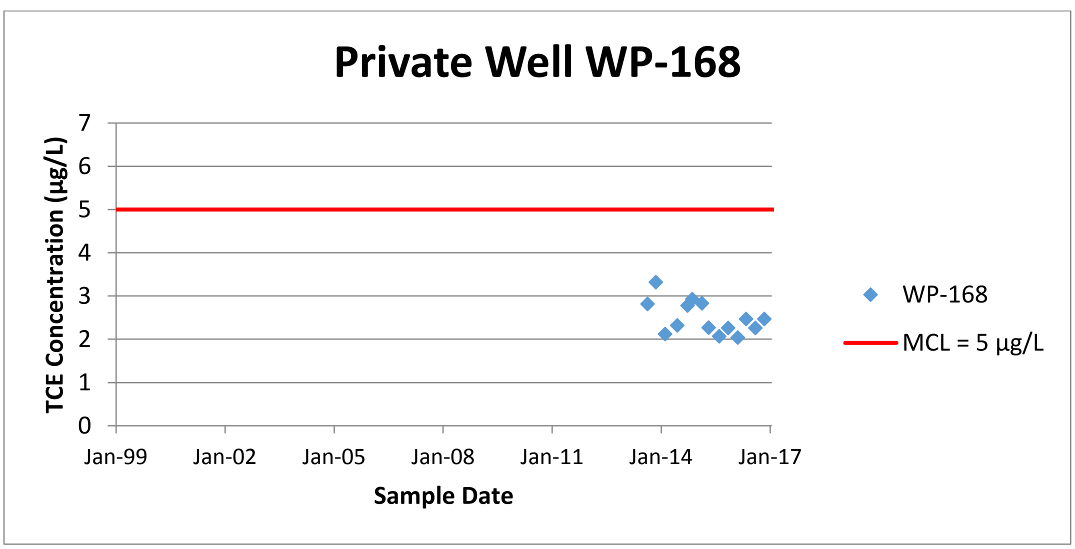

Private Well WP-153
TCE Concentration (µg/L)
7
6
5
4
3
2
1
0
Jan-99
Jan-02
Jan-05
Jan-08
Jan-11
Jan-14
Jan-17
Sample Date
WP-153
MCL = 5 µg/L

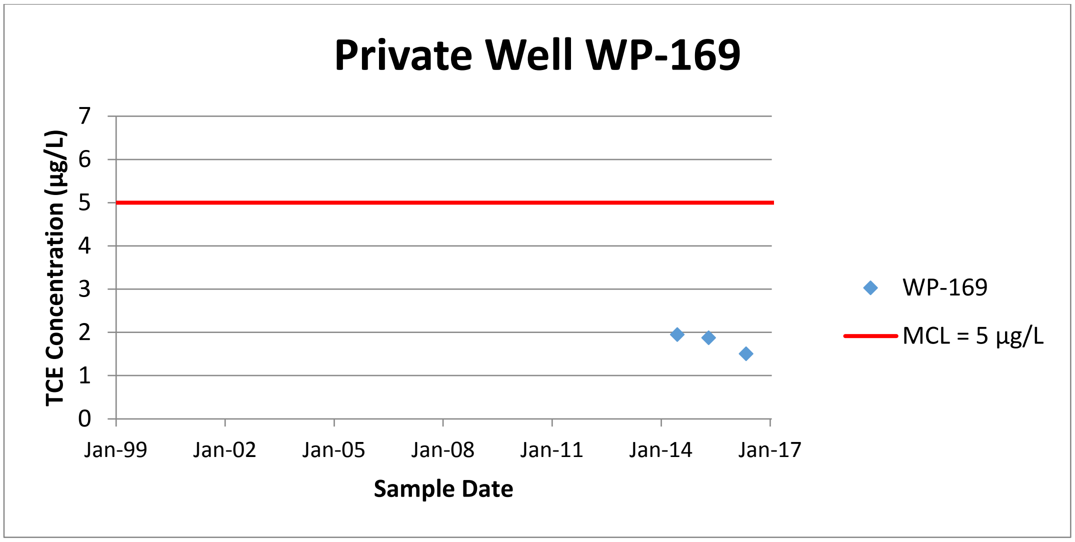

Private Well WP-154
TCE Concentration (µg/L)
7
6
5
4
3
2
1
0
Jan-99
Jan-02
Jan-05
Jan-08
Jan-11
Jan-14
Jan-17
Sample Date
WP-154
MCL = 5 µg/L

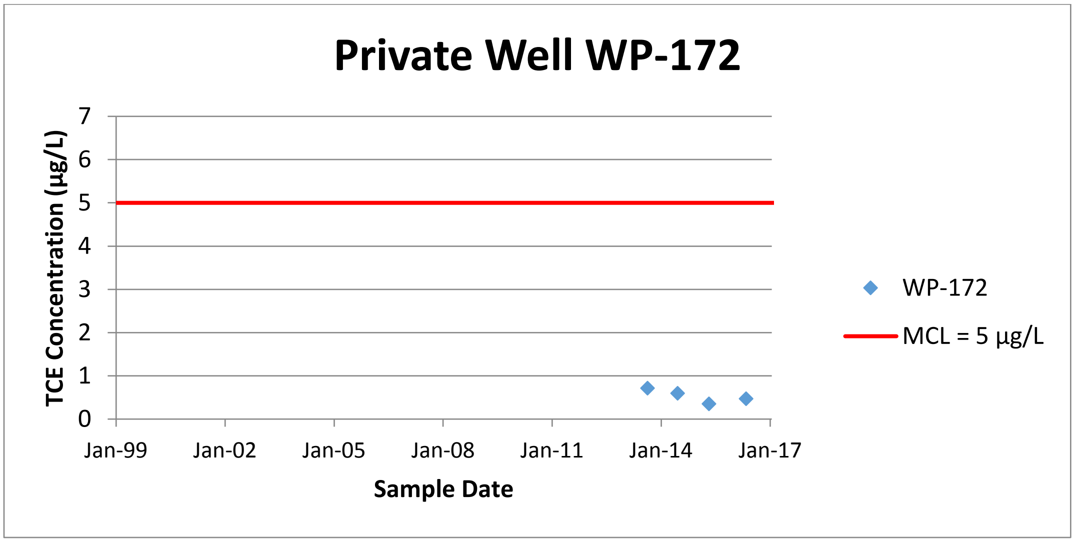

Private Well WP-155
TCE Concentration (µg/L)
7
6
5
4
3
2
1
0
Jan-99
Jan-02
Jan-05
Jan-08
Jan-11
Jan-14
Jan-17
Sample Date
WP-155
MCL = 5 µg/L

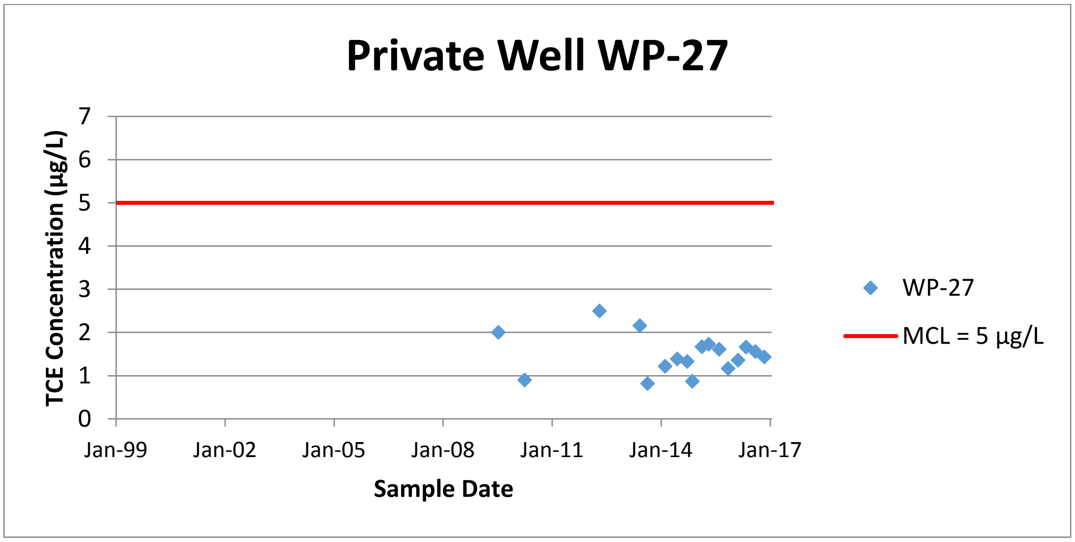

Private Well WP-156
TCE Concentration (µg/L)
7
6
5
4
3
2
1
0
Jan-99
Jan-02
Jan-05
Jan-08
Jan-11
Jan-14
Jan-17
Sample Date
WP-156
MCL = 5 µg/L

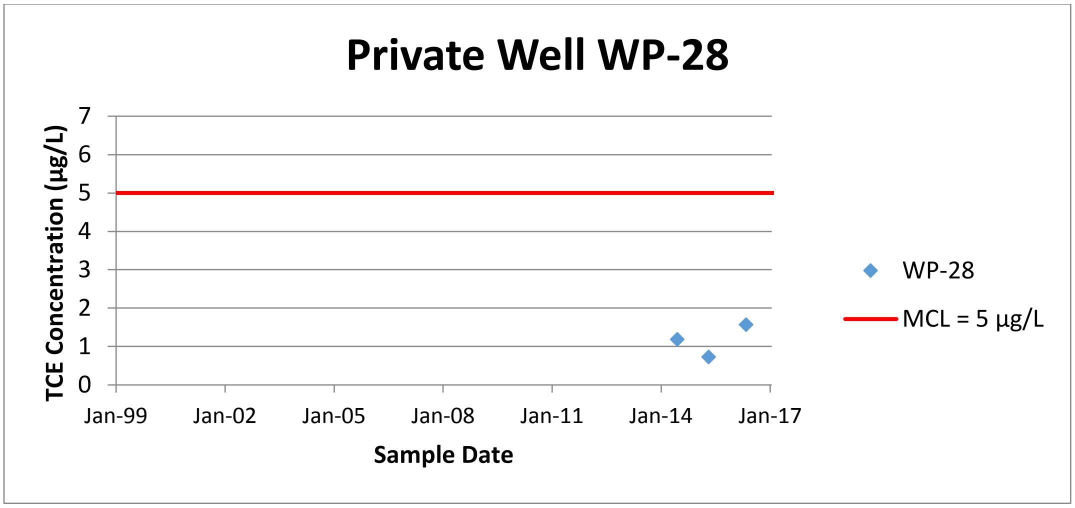

Private Well WP-167
TCE Concentration (µg/L)
7
6
5
4
3
2
1
0
Jan-99
Jan-02
Jan-05
Jan-08
Jan-11
Jan-14
Jan-17
Sample Date
WP-167
MCL = 5 µg/L

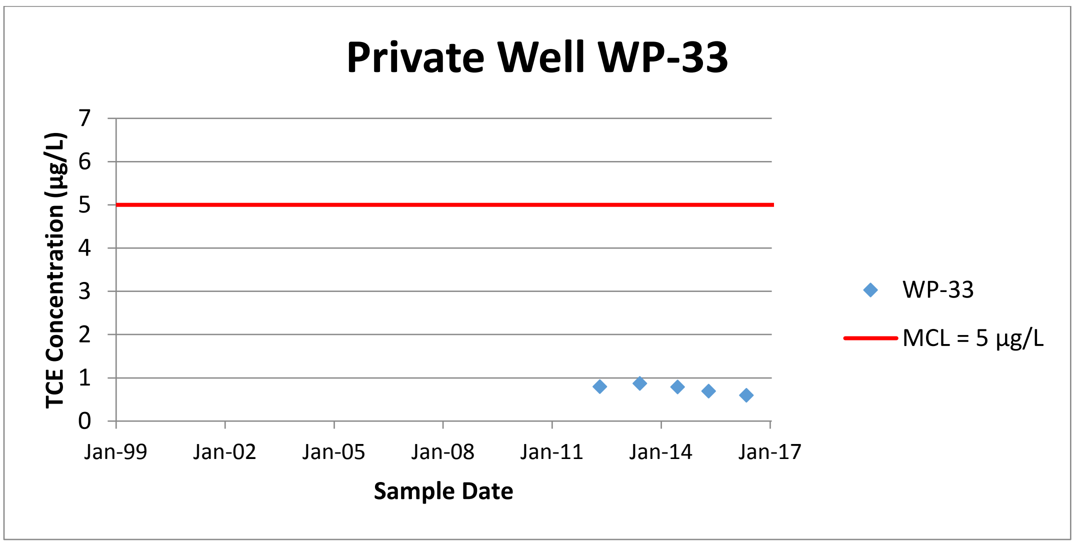

Private Well WP-168
TCE Concentration (µg/L)
7
6
5
4
3
2
1
0
Jan-99
Jan-02
Jan-05
Jan-08
Jan-11
Jan-14
Jan-17
Sample Date
WP-168
MCL = 5 µg/L

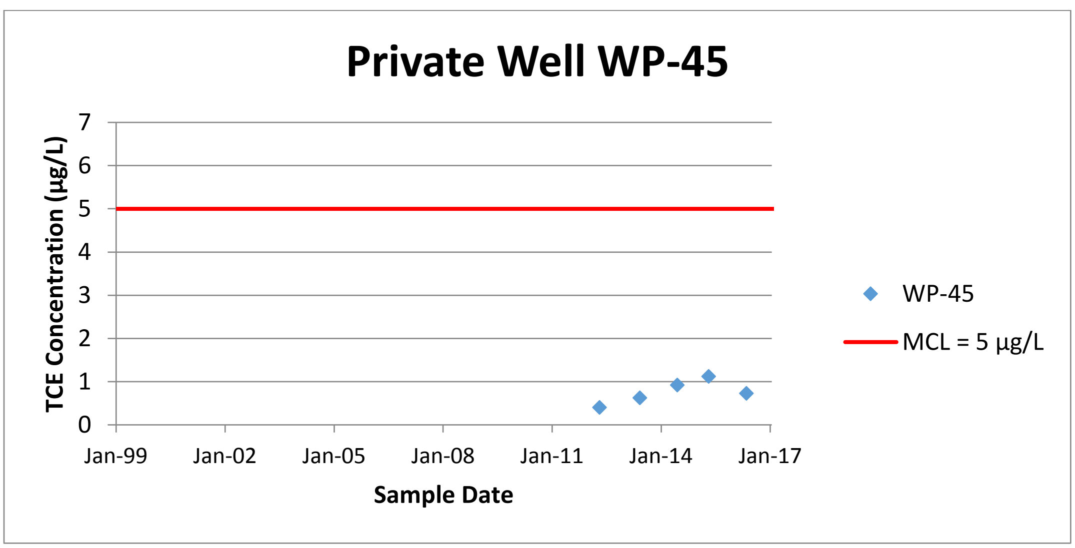

Private Well WP-169
TCE Concentration (µg/L)
0
1
2
3
4
5
6
7
Jan-99
Jan-02
Jan-05
Jan-08
Jan-11
Jan-14
Jan-17
Sample Date
WP-169
MCL = 5 µg/L

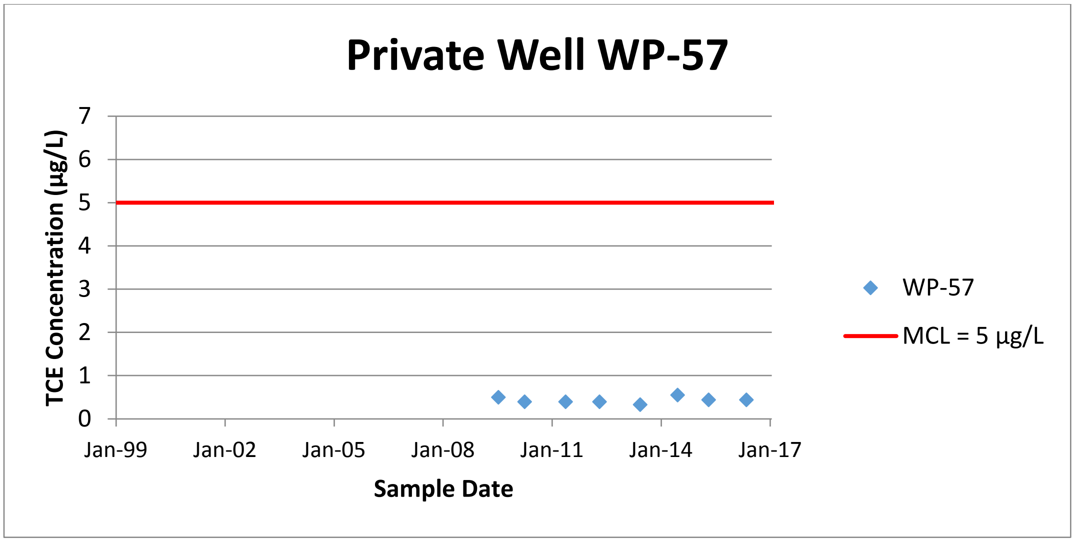

Private Well WP-172
TCE Concentration (µg/L)
0
1
2
3
4
5
6
7
Jan-99
Jan-02
Jan-05
Jan-08
Jan-11
Jan-14
Jan-17
Sample Date
WP-172
MCL = 5 µg/L

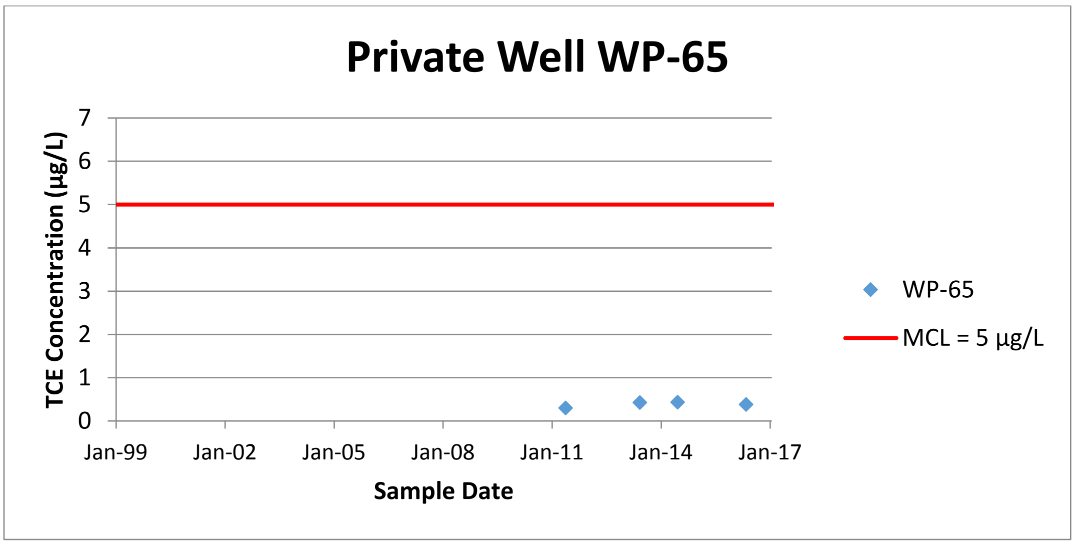

Private Well WP-27
TCE Concentration (µg/L)
0
1
2
3
4
5
6
7
Jan-99
Jan-02
Jan-05
Jan-08
Jan-11
Jan-14
Jan-17
Sample Date
WP-27
MCL = 5 µg/L

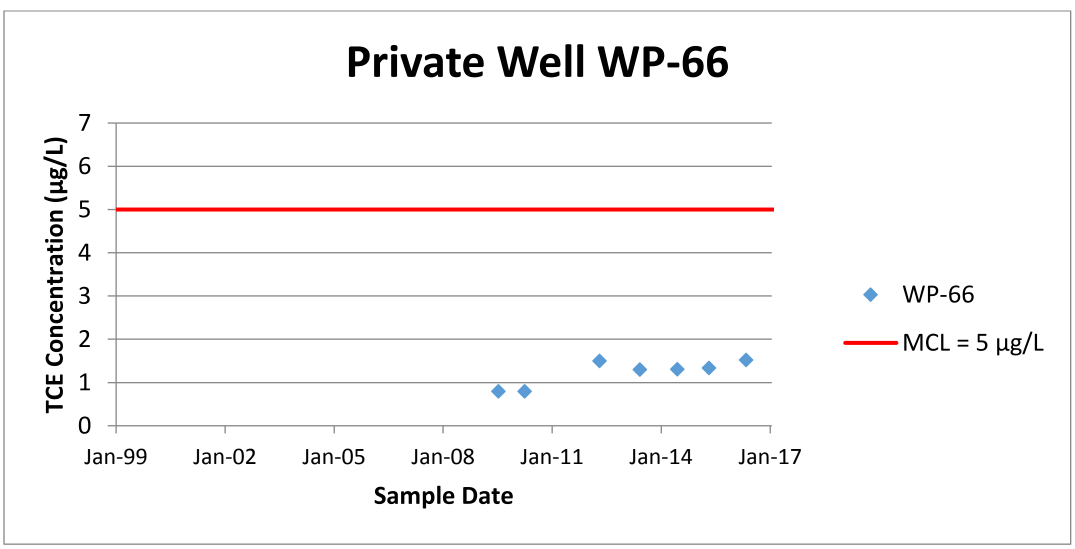

Private Well WP-28
TCE Concentration (µg/L)
7
6
5
4
3
2
1
0
Jan-99
Jan-02
Jan-05
Jan-08
Jan-11
Jan-14
Jan-17
Sample Date
WP-28
MCL = 5 µg/L

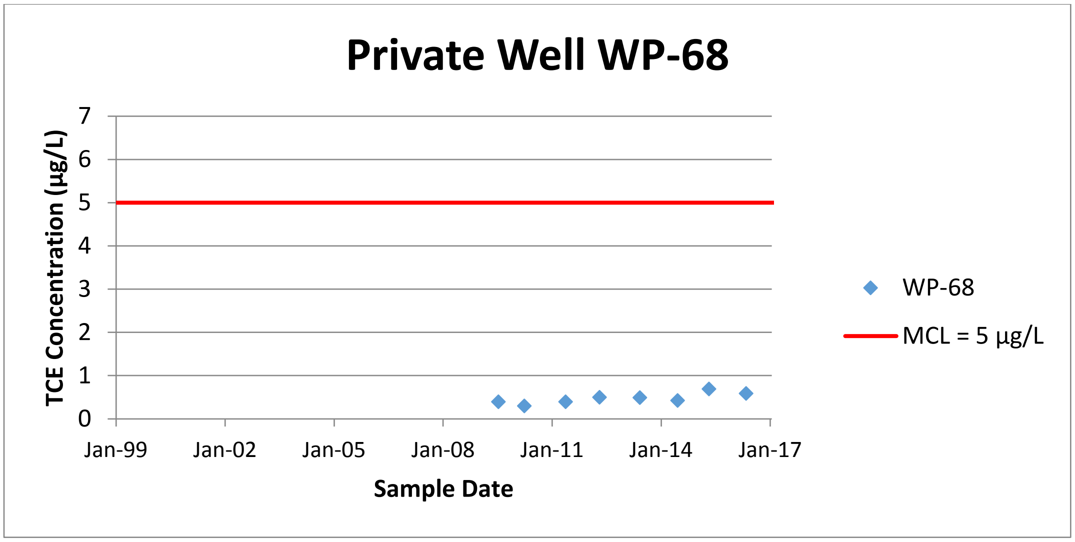

Private Well WP-33
TCE Concentration (µg/L)
7
6
5
4
3
2
1
0
Jan-99
Jan-02
Jan-05
Jan-08
Jan-11
Jan-14
Jan-17
Sample Date
WP-33
MCL = 5 µg/L

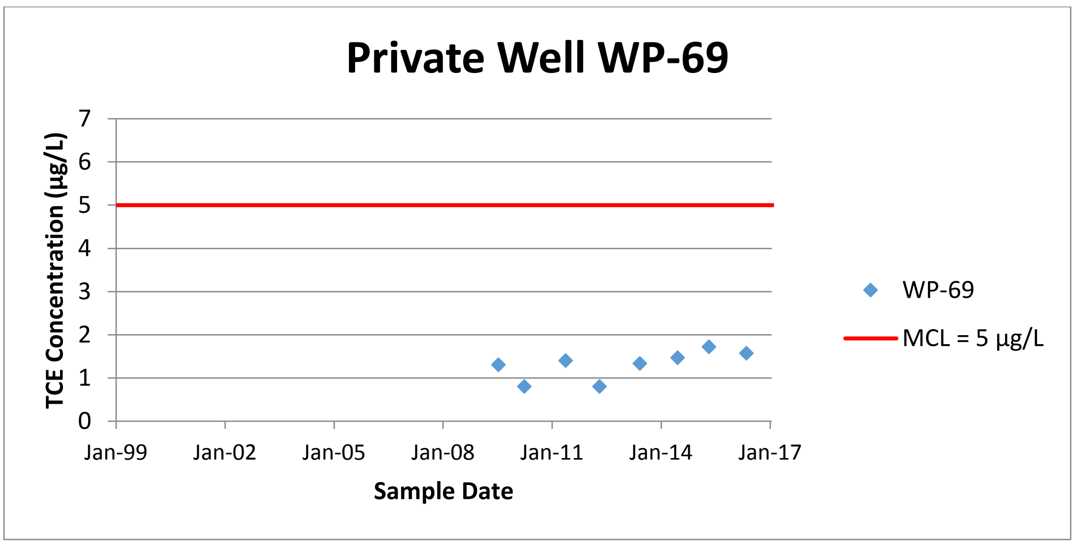

Private Well WP-45
TCE Concentration (µg/L)
7
6
5
4
3
2
1
0
Jan-99
Jan-02
Jan-05
Jan-08
Jan-11
Jan-14
Jan-17
Sample Date
WP-45
MCL = 5 µg/L

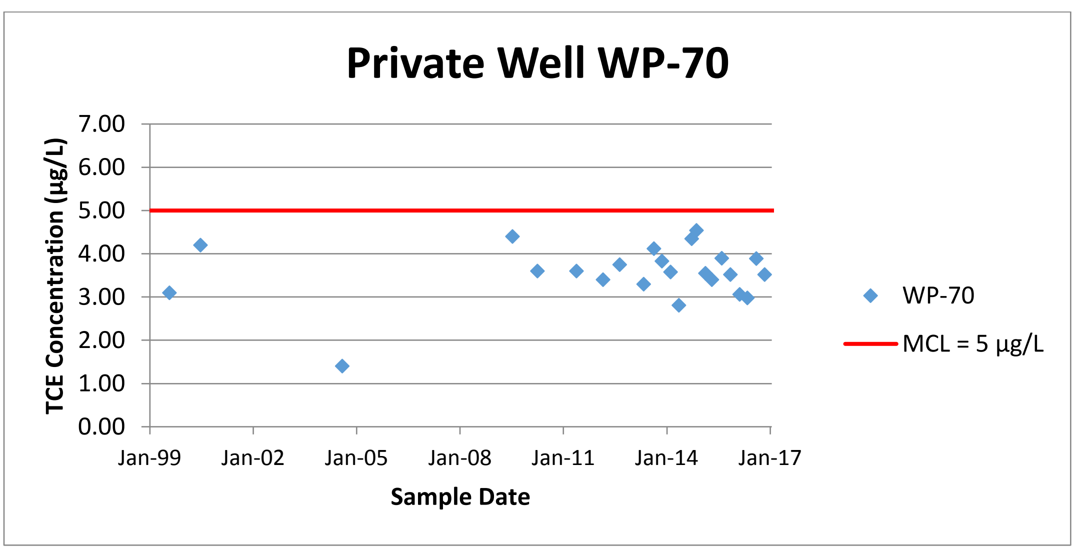

Private Well WP-57
TCE Concentration (µg/L)
7
6
5
4
3
2
1
0
Jan-99
Jan-02
Jan-05
Jan-08
Jan-11
Jan-14
Jan-17
Sample Date
WP-57
MCL = 5 µg/L

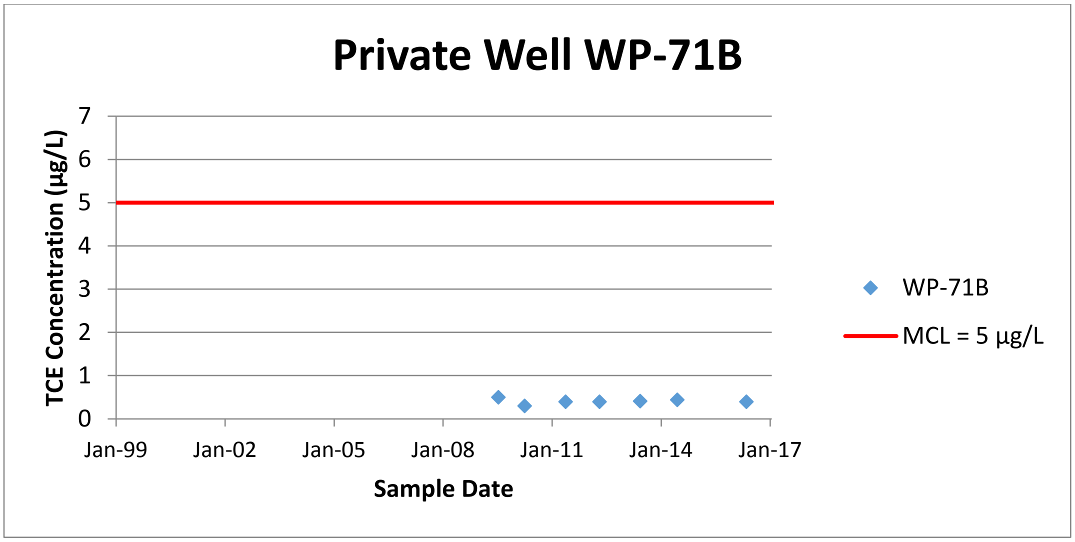

Private Well WP-65
TCE Concentration (µg/L)
7
6
5
4
3
2
1
0
Jan-99
Jan-02
Jan-05
Jan-08
Jan-11
Jan-14
Jan-17
Sample Date
WP-65
MCL = 5 µg/L

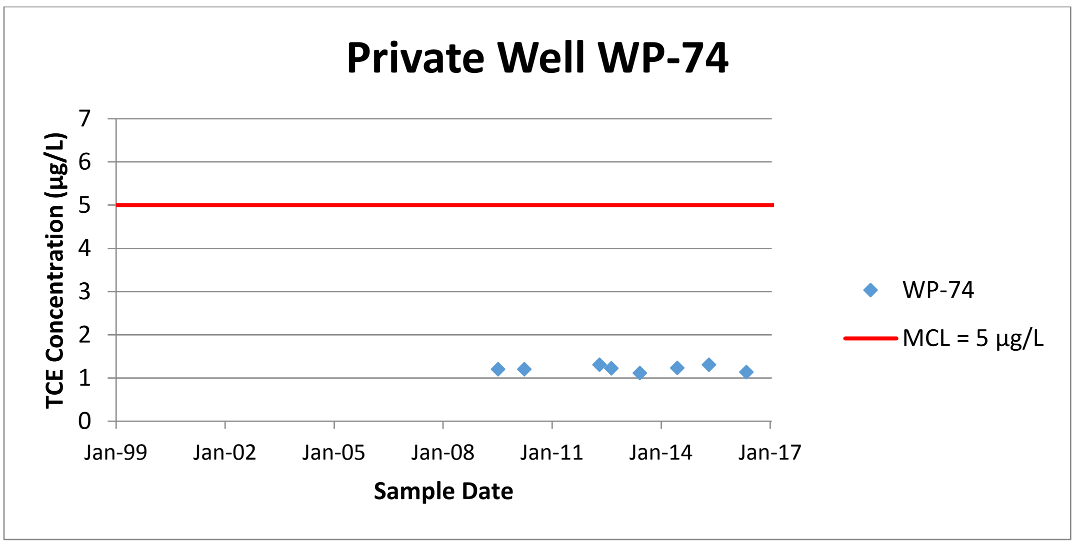

Private Well WP-66
TCE Concentration (µg/L)
7
6
5
4
3
2
1
0
Jan-99
Jan-02
Jan-05
Jan-08
Jan-11
Jan-14
Jan-17
Sample Date
WP-66
MCL = 5 µg/L

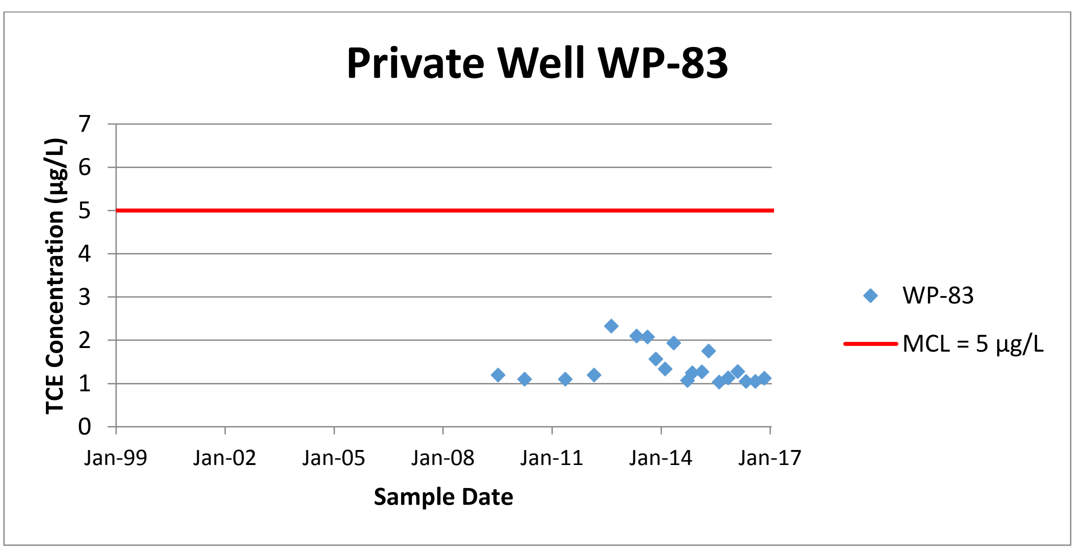

Private Well WP-68
TCE Concentration (µg/L)
7
6
5
4
3
2
1
0
Jan-99
Jan-02
Jan-05
Jan-08
Jan-11
Jan-14
Jan-17
Sample Date
WP-68
MCL = 5 µg/L

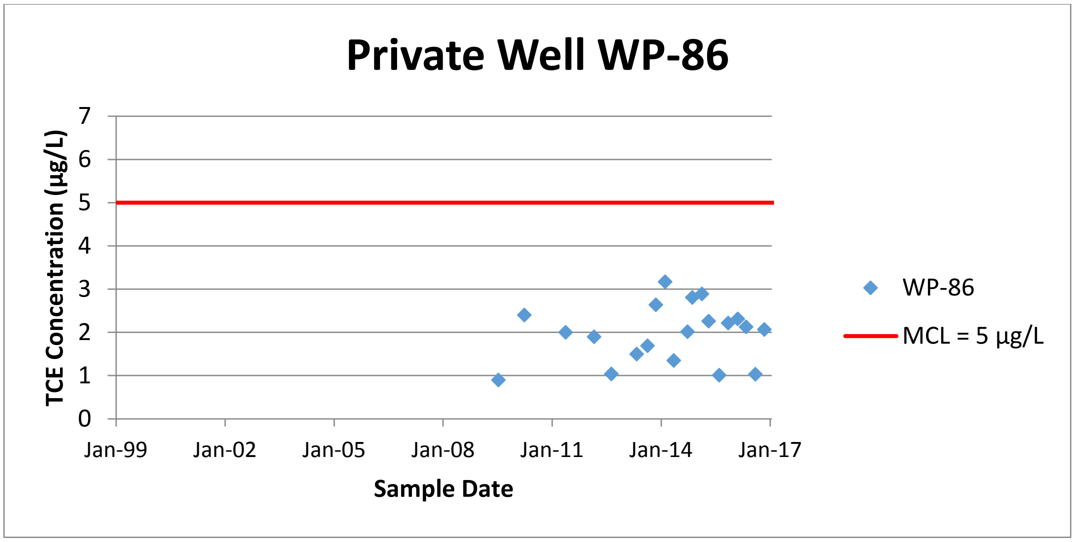

Private Well WP-69
TCE Concentration (µg/L)
7
6
5
4
3
2
1
0
Jan-99
Jan-02
Jan-05
Jan-08
Jan-11
Jan-14
Jan-17
Sample Date
WP-69
MCL = 5 µg/L

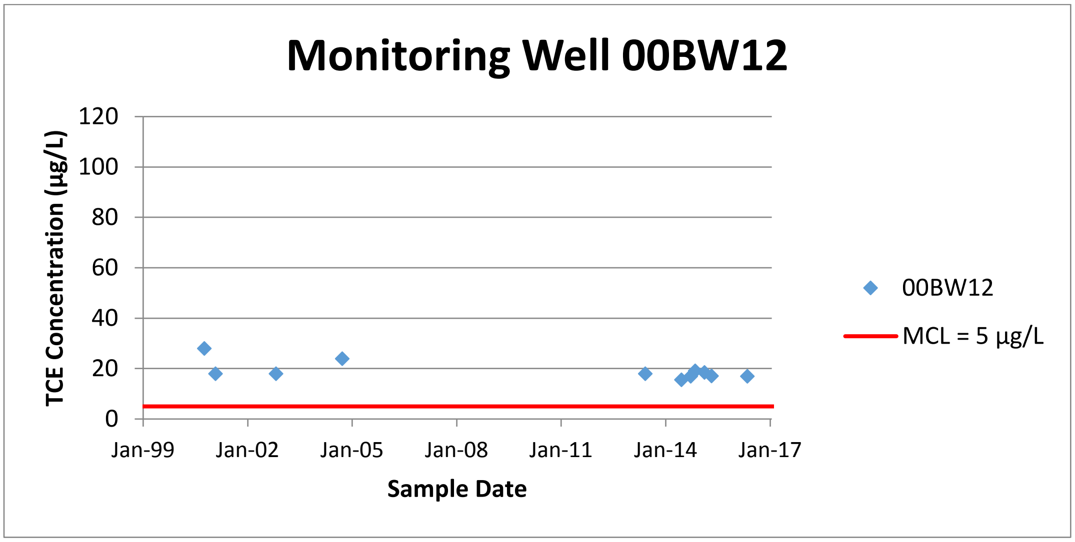

Private Well WP-70
TCE Concentration (µg/L)
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
Jan-99
Jan-02
Jan-05
Jan-08
Jan-11
Jan-14
Jan-17
Sample Date
WP-70
MCL = 5 µg/L


Private Well WP-71B
TCE Concentration (µg/L)
7
6
5
4
3
2
1
0
Jan-99
Jan-02
Jan-05
Jan-08
Jan-11
Jan-14
Jan-17
Sample Date
WP-71B
MCL = 5 µg/L

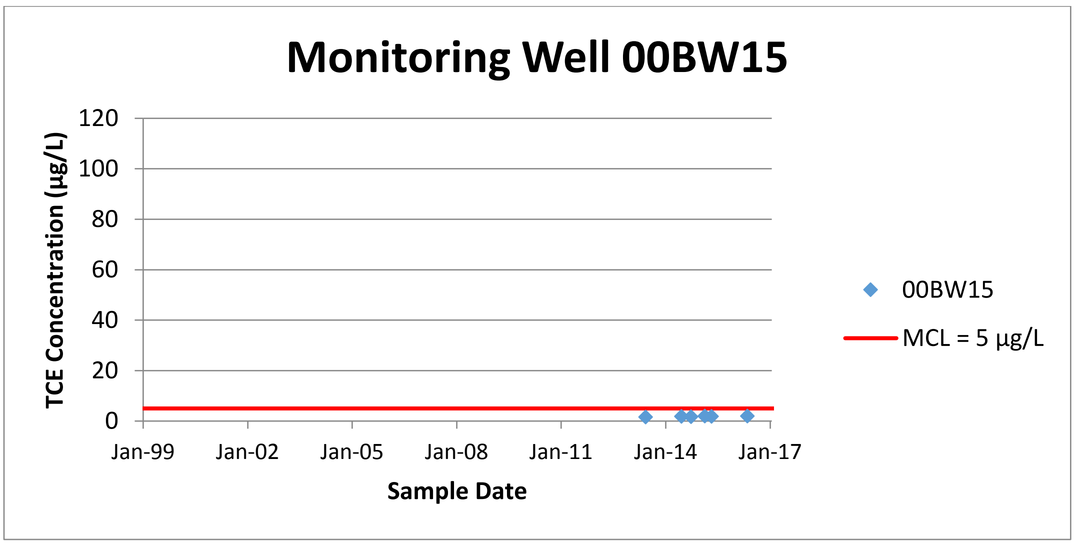

Private Well WP-74
TCE Concentration (µg/L)
7
6
5
4
3
2
1
0
Jan-99
Jan-02
Jan-05
Jan-08
Jan-11
Jan-14
Jan-17
Sample Date
WP-74
MCL = 5 µg/L


Private Well WP-83
TCE Concentration (µg/L)
7
6
5
4
3
2
1
0
Jan-99
Jan-02
Jan-05
Jan-08
Jan-11
Jan-14
Jan-17
Sample Date
WP-83
MCL = 5 µg/L

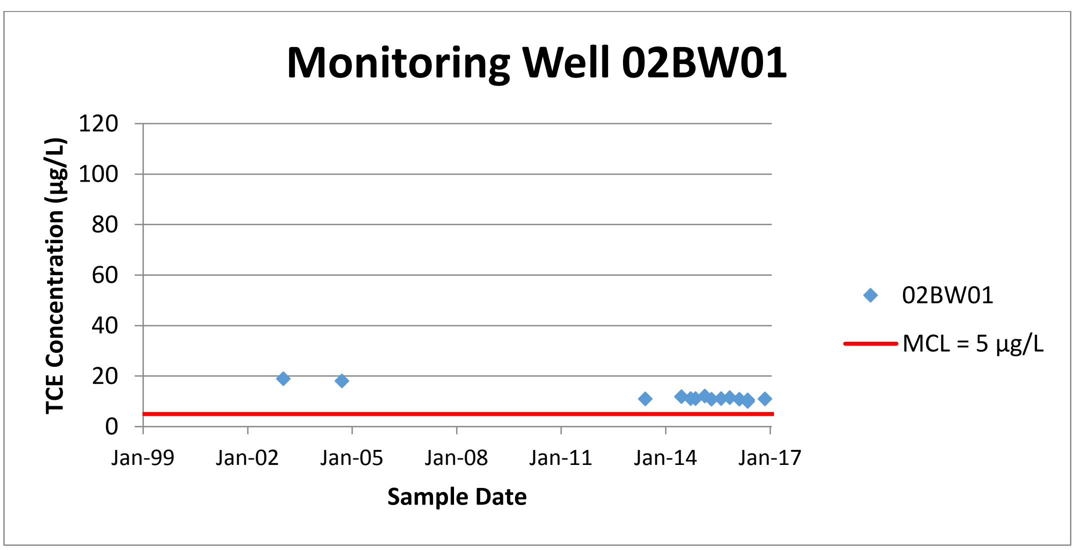

Private Well WP-86
TCE Concentration (µg/L)
0
1
2
3
4
5
6
7
Jan-99
Jan-02
Jan-05
Jan-08
Jan-11
Jan-14
Jan-17
Sample Date
WP-86
MCL = 5 µg/L



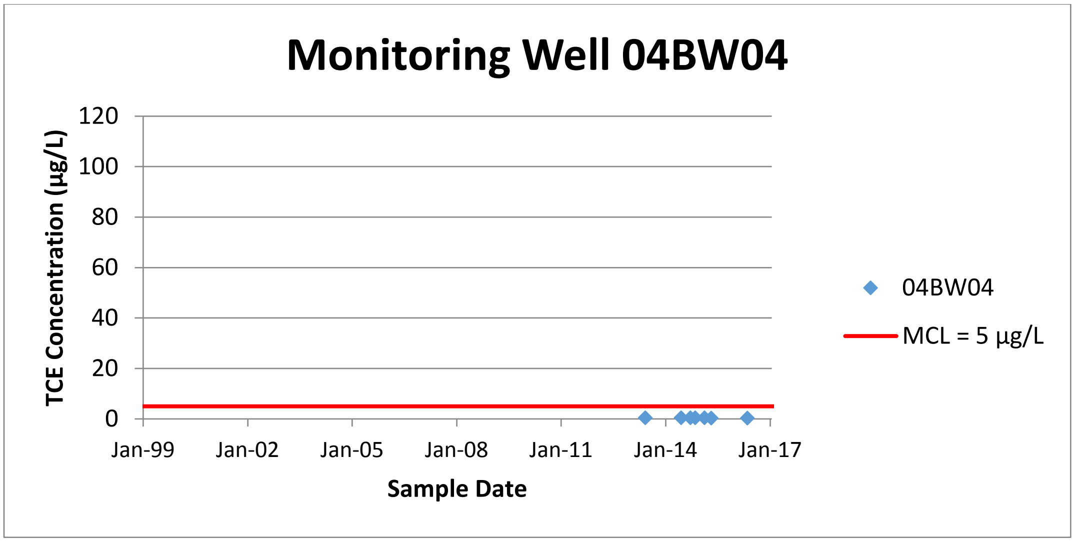
Monitoring Well 00BW12
TCE Concentration (µg/L)
120
100
80
60
40
20
0
Jan-99
Jan-02
Jan-05
Jan-08
Jan-11
Jan-14
Jan-17
Sample Date
00BW12
MCL = 5 µg/L

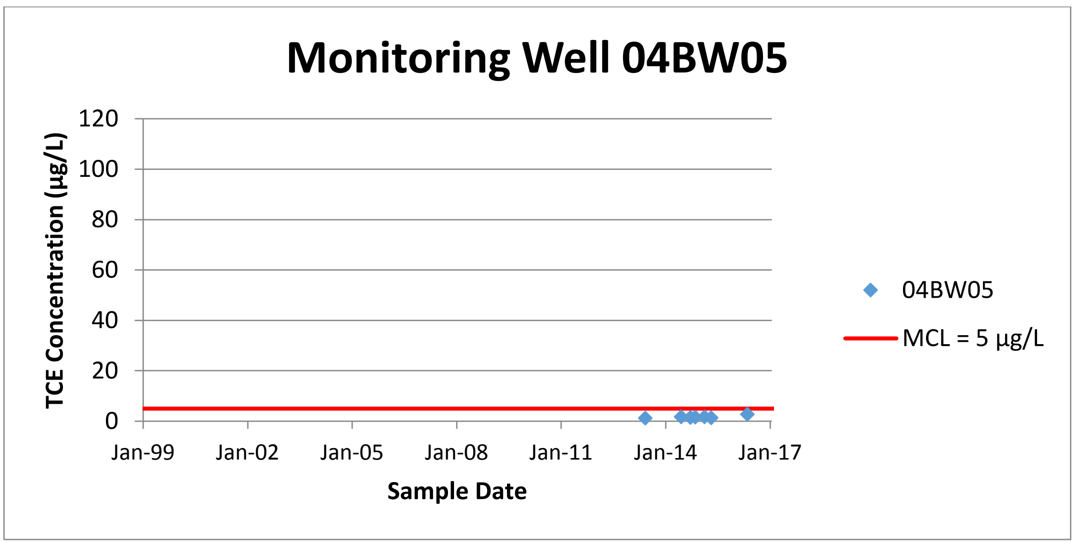


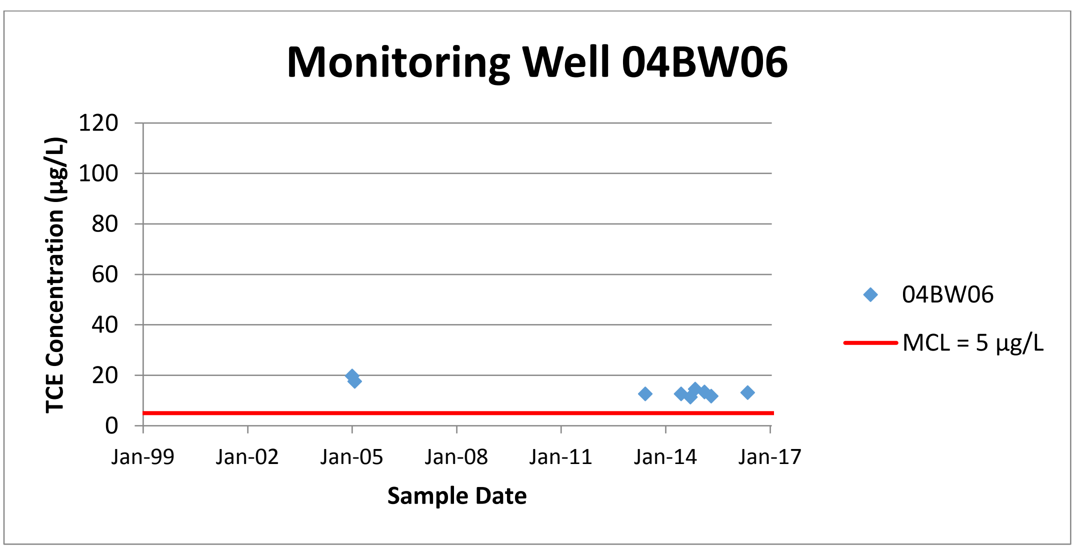
Monitoring Well 00BW15
TCE Concentration (µg/L)
120
100
80
60
40
20
0
Jan-99
Jan-02
Jan-05
Jan-08
Jan-11
Jan-14
Jan-17
Sample Date
00BW15
MCL = 5 µg/L

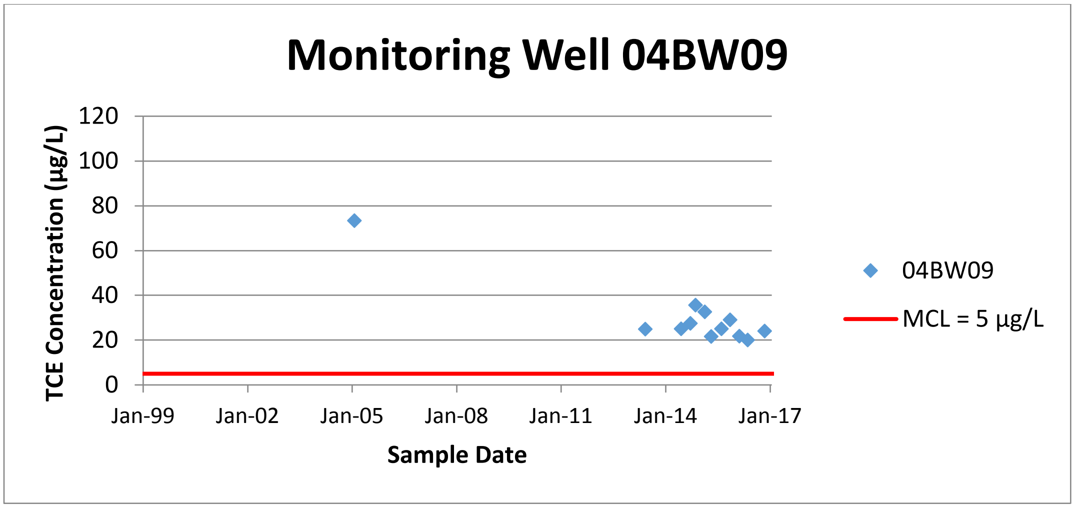


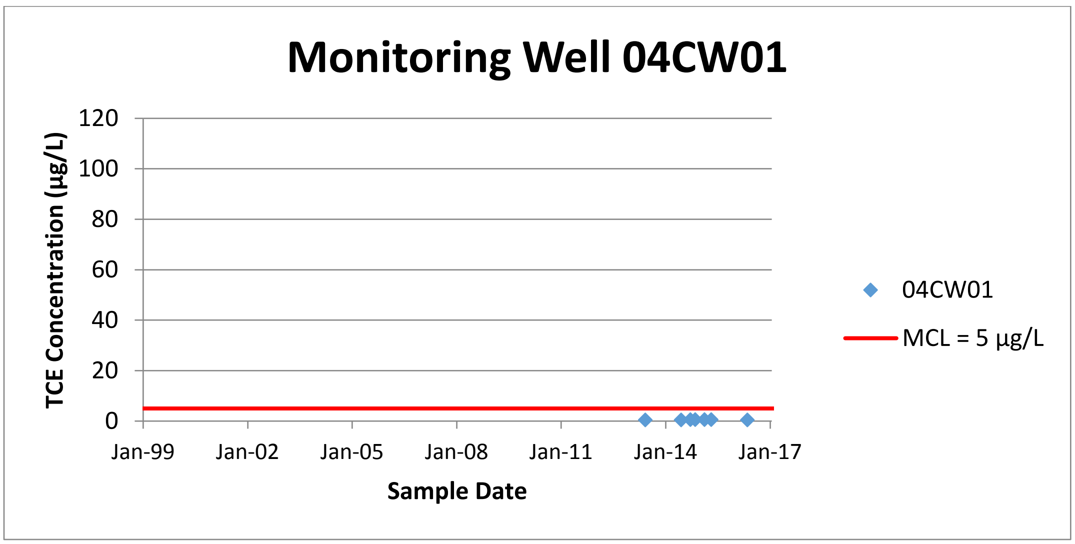
Monitoring Well 02BW01
TCE Concentration (µg/L)
120
100
80
60
40
20
0
Jan-99
Jan-02
Jan-05
Jan-08
Jan-11
Jan-14
Jan-17
Sample Date
02BW01
MCL = 5 µg/L

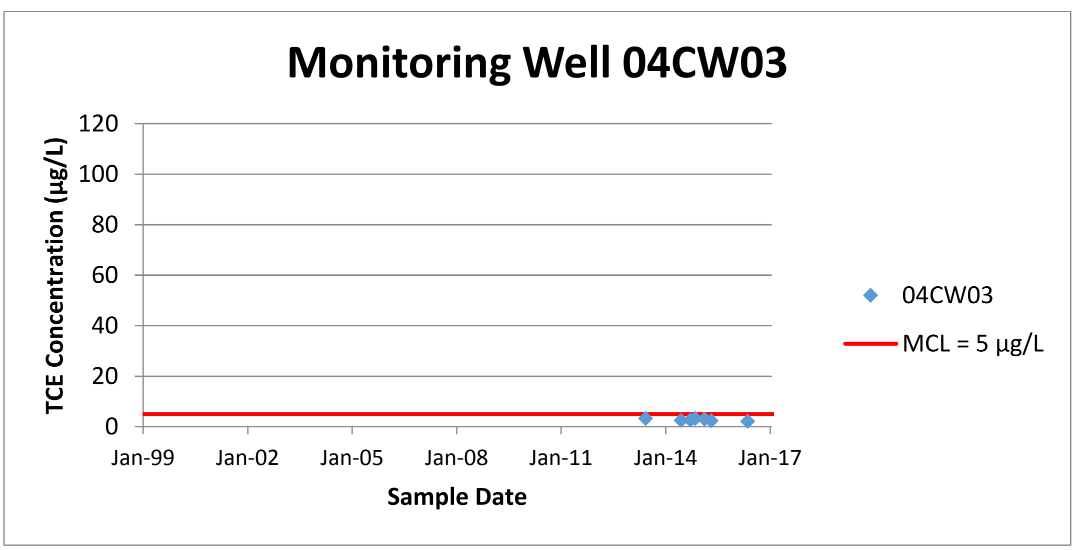

Monitoring Well 04BW04
TCE Concentration (µg/L)
120
100
80
60
40
20
0
Jan-99
Jan-02
Jan-05
Jan-08
Jan-11
Jan-14
Jan-17
Sample Date
04BW04
MCL = 5 µg/L

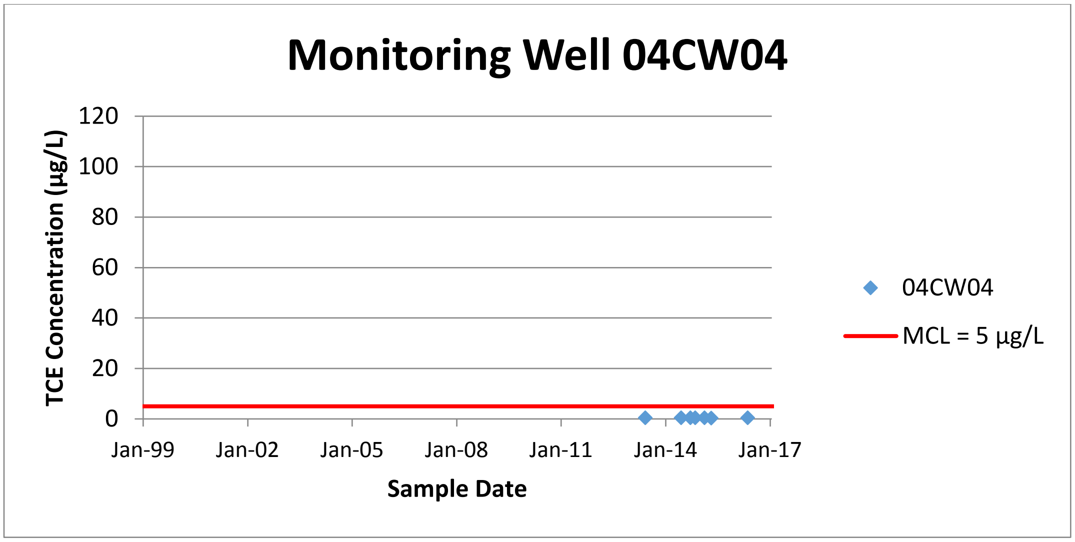

Monitoring Well 04BW05
TCE Concentration (µg/L)
120
100
80
60
40
20
0
Jan-99
Jan-02
Jan-05
Jan-08
Jan-11
Jan-14
Jan-17
Sample Date
04BW05
MCL = 5 µg/L

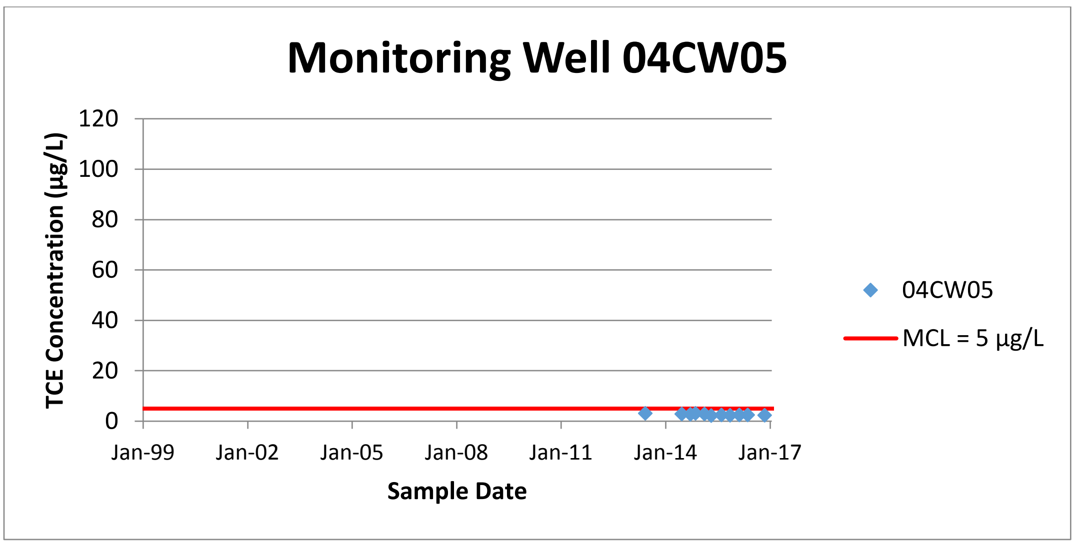

Monitoring Well 04BW06
TCE Concentration (µg/L)
120
100
80
60
40
20
0
Jan-99
Jan-02
Jan-05
Jan-08
Jan-11
Jan-14
Jan-17
Sample Date
04BW06
MCL = 5 µg/L

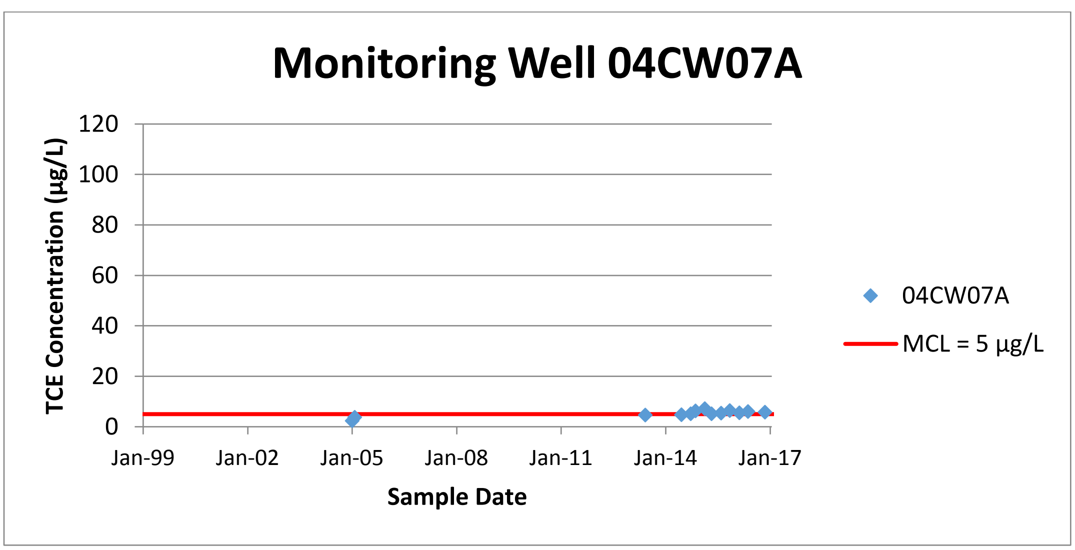

Monitoring Well 04BW09
TCE Concentration (µg/L)
120
100
80
60
40
20
0
Jan-99
Jan-02
Jan-05
Jan-08
Jan-11
Jan-14
Jan-17
Sample Date
04BW09
MCL = 5 µg/L

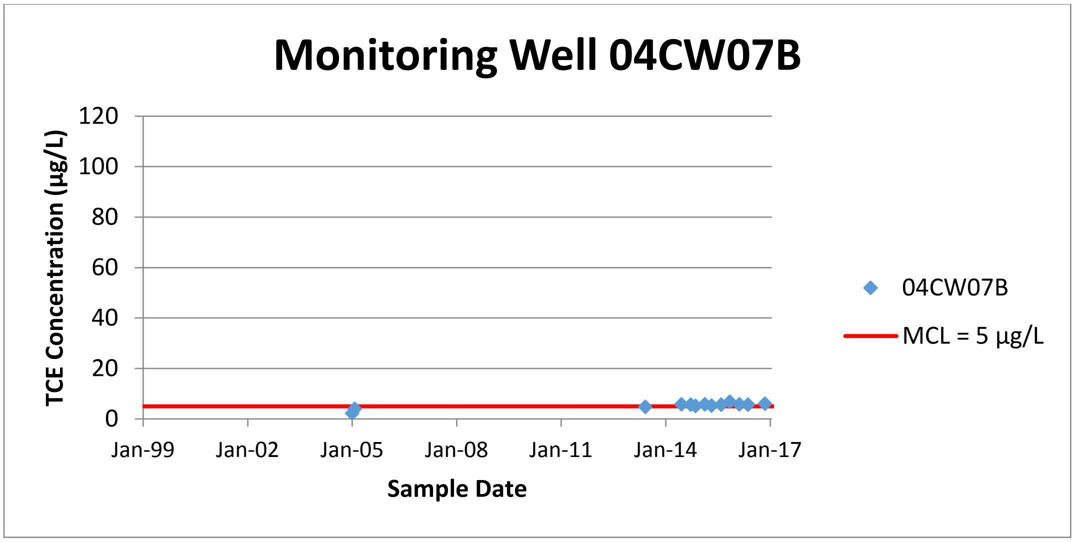

Monitoring Well 04CW01
TCE Concentration (µg/L)
120
100
80
60
40
20
0
Jan-99
Jan-02
Jan-05
Jan-08
Jan-11
Jan-14
Jan-17
Sample Date
04CW01
MCL = 5 µg/L

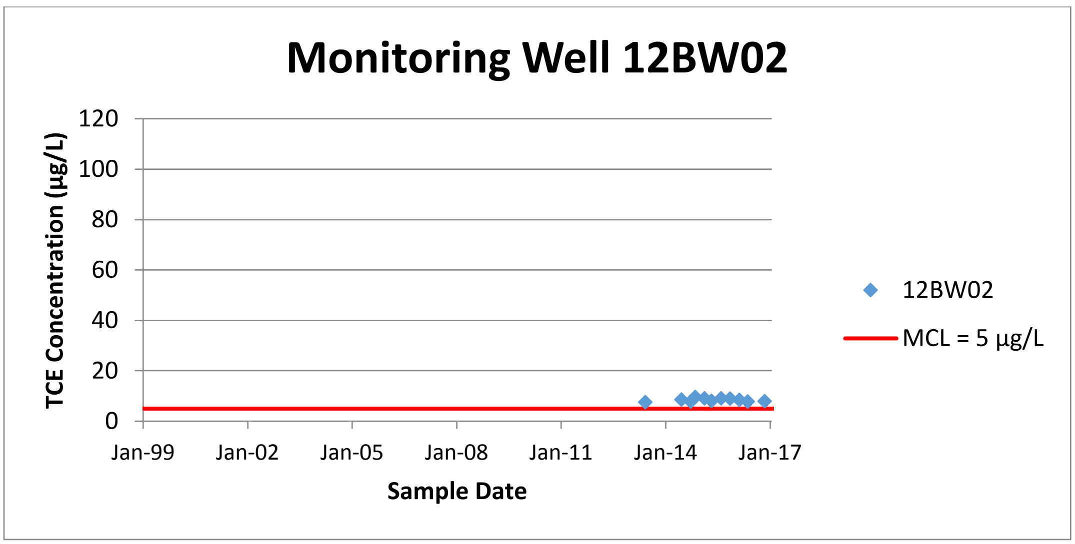

Monitoring Well 04CW03
TCE Concentration (µg/L)
120
100
80
60
40
20
0
Jan-99
Jan-02
Jan-05
Jan-08
Jan-11
Jan-14
Jan-17
Sample Date
04CW03
MCL = 5 µg/L

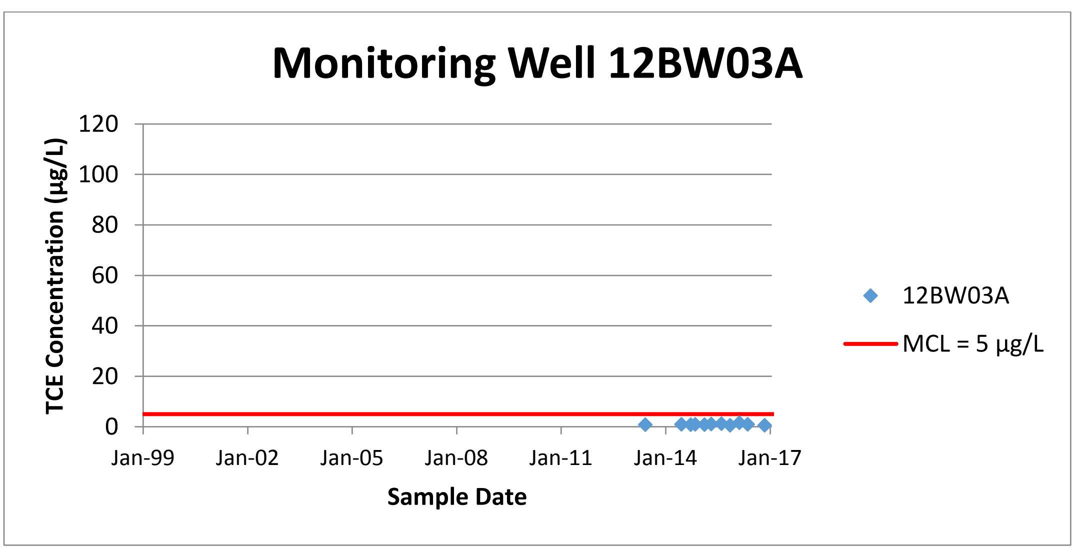

Monitoring Well 04CW04
TCE Concentration (µg/L)
120
100
80
60
40
20
0
Jan-99
Jan-02
Jan-05
Jan-08
Jan-11
Jan-14
Jan-17
Sample Date
04CW04
MCL = 5 µg/L

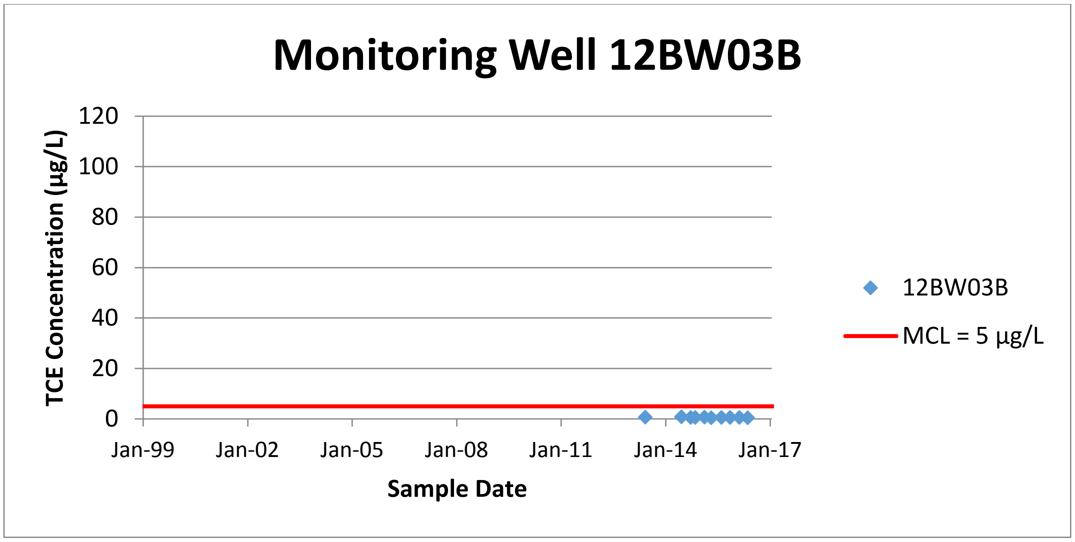

Monitoring Well 04CW05
TCE Concentration (µg/L)
120
100
80
60
40
20
0
Jan-99
Jan-02
Jan-05
Jan-08
Jan-11
Jan-14
Jan-17
Sample Date
04CW05
MCL = 5 µg/L

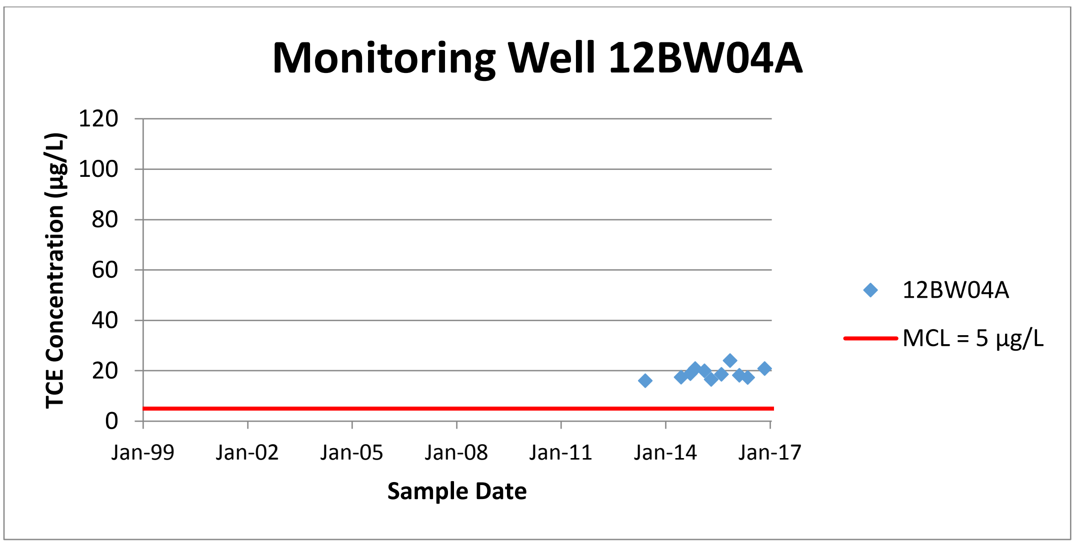

Monitoring Well 04CW07A
TCE Concentration (µg/L)
120
100
80
60
40
20
0
Jan-99
Jan-02
Jan-05
Jan-08
Jan-11
Jan-14
Jan-17
Sample Date
04CW07A
MCL = 5 µg/L

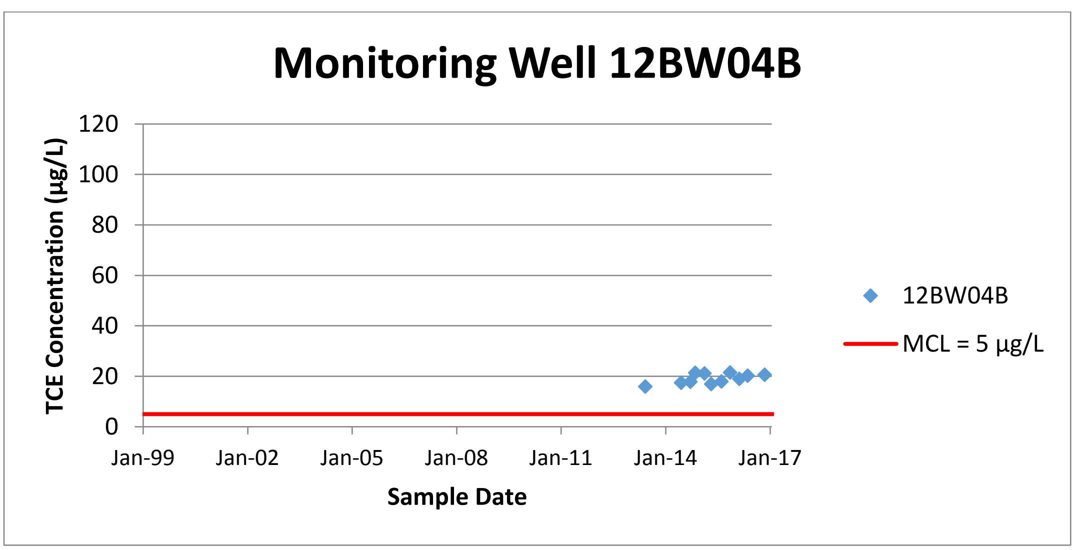

Monitoring Well 04CW07B
TCE Concentration (µg/L)
120
100
80
60
40
20
0
Jan-99
Jan-02
Jan-05
Jan-08
Jan-11
Jan-14
Jan-17
Sample Date
04CW07B
MCL = 5 µg/L

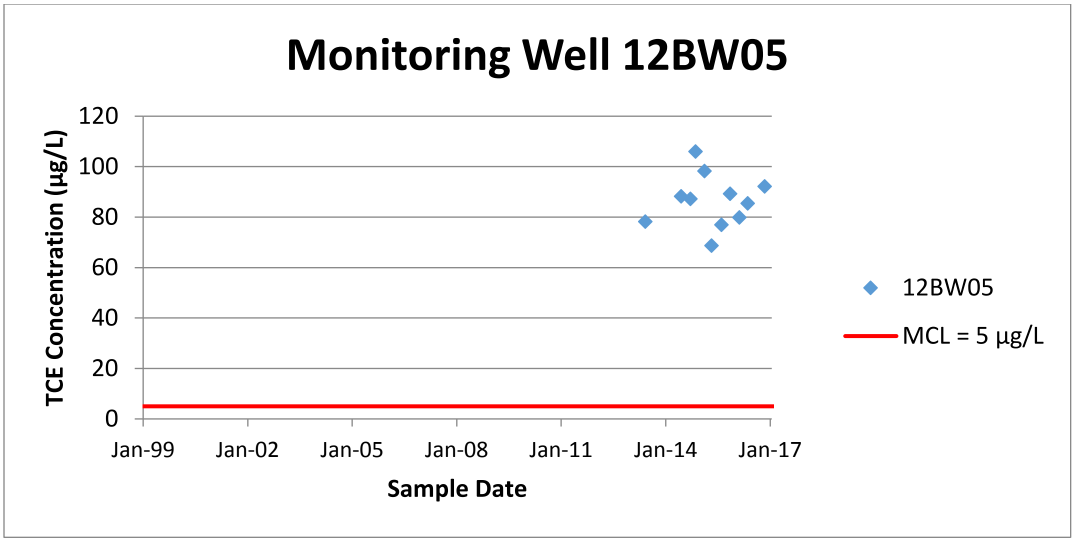

Monitoring Well 12BW02
TCE Concentration (µg/L)
120
100
80
60
40
20
0
Jan-99
Jan-02
Jan-05
Jan-08
Jan-11
Jan-14
Jan-17
Sample Date
12BW02
MCL = 5 µg/L

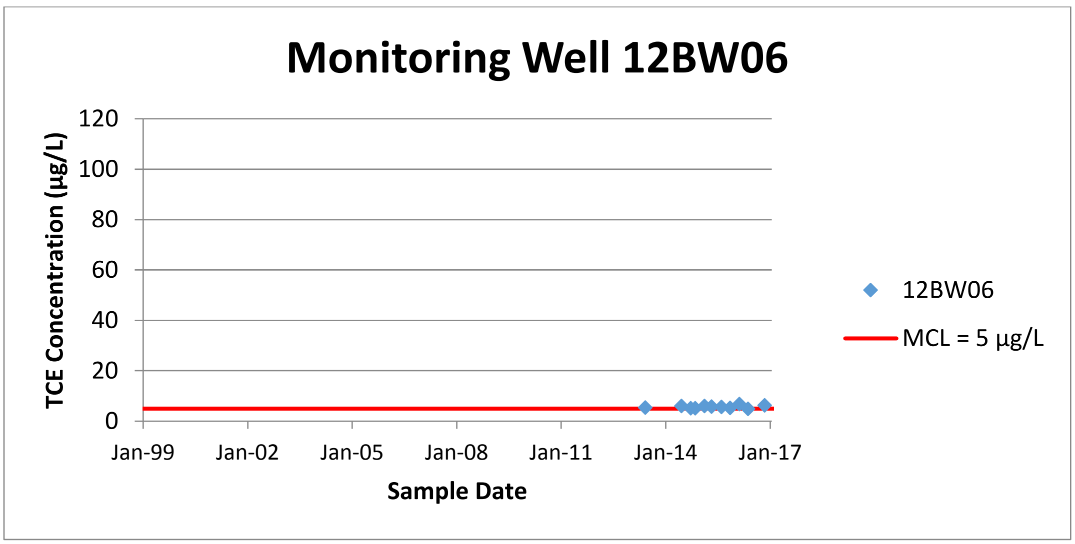

Monitoring Well 12BW03A
TCE Concentration (µg/L)
120
100
80
60
40
20
0
Jan-99
Jan-02
Jan-05
Jan-08
Jan-11
Jan-14
Jan-17
Sample Date
12BW03A
MCL = 5 µg/L

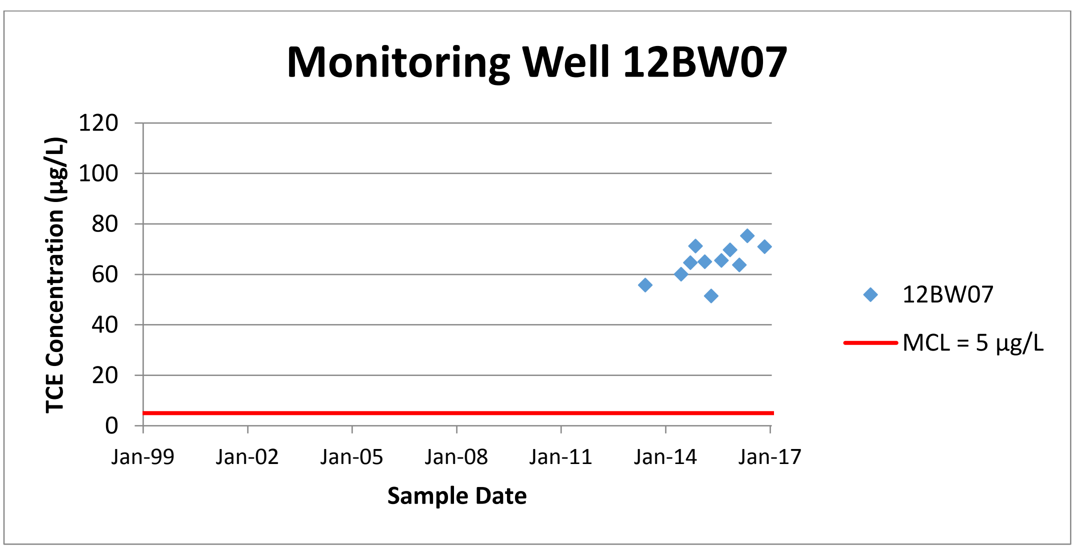

Monitoring Well 12BW03B
TCE Concentration (µg/L)
120
100
80
60
40
20
0
Jan-99
Jan-02
Jan-05
Jan-08
Jan-11
Jan-14
Jan-17
Sample Date
12BW03B
MCL = 5 µg/L

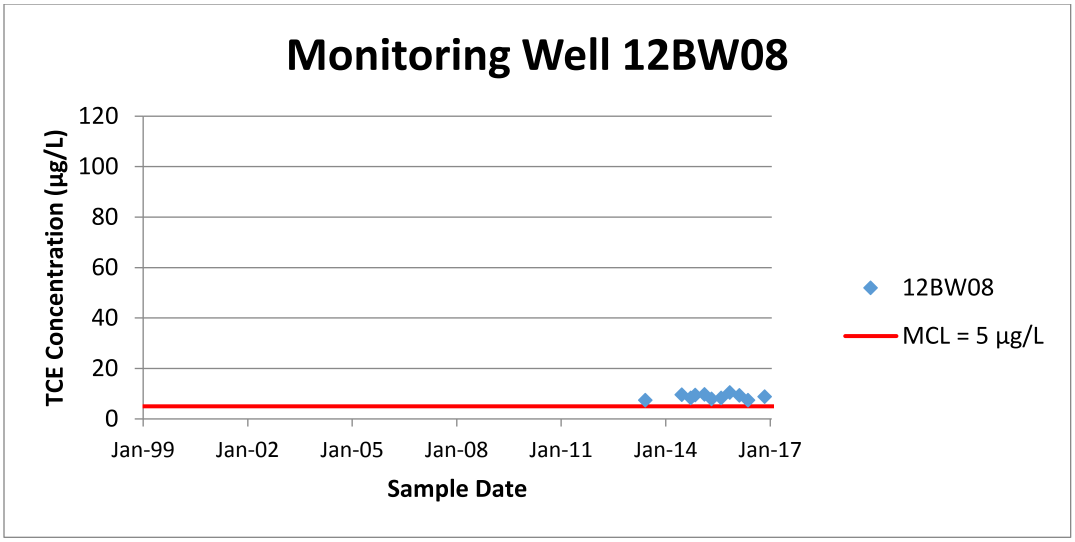

Monitoring Well 12BW04A
TCE Concentration (µg/L)
120
100
80
60
40
20
0
Jan-99
Jan-02
Jan-05
Jan-08
Jan-11
Jan-14
Jan-17
Sample Date
12BW04A
MCL = 5 µg/L

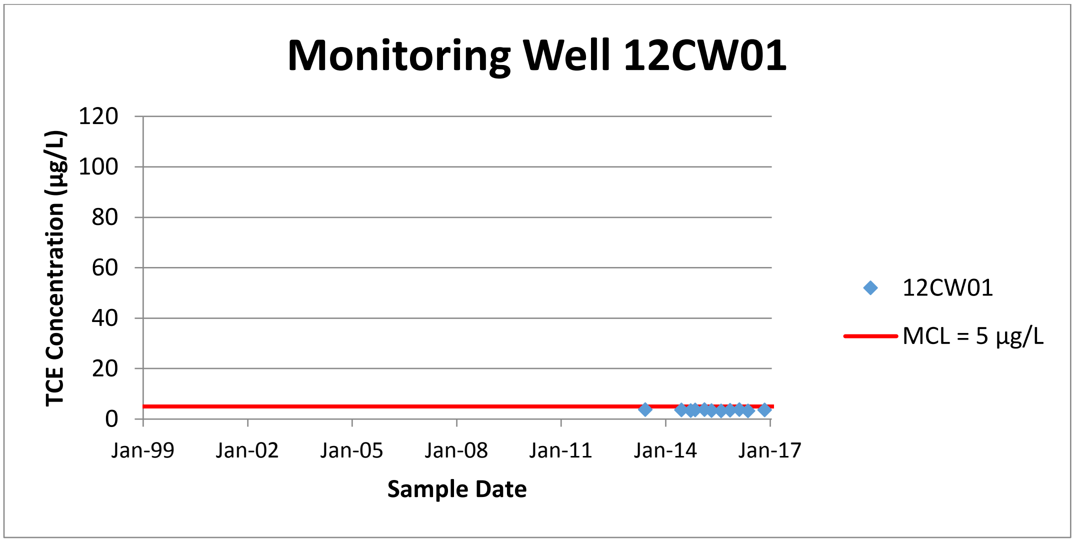

Monitoring Well 12BW04B
TCE Concentration (µg/L)
120
100
80
60
40
20
0
Jan-99
Jan-02
Jan-05
Jan-08
Jan-11
Jan-14
Jan-17
Sample Date
12BW04B
MCL = 5 µg/L

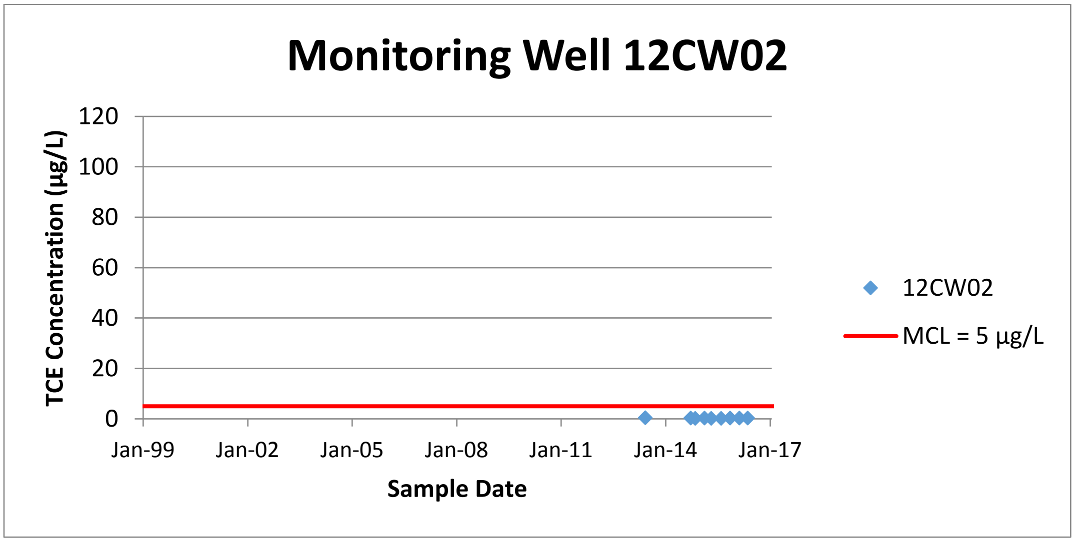

Monitoring Well 12BW05
TCE Concentration (µg/L)
0
20
40
60
80
100
120
Jan-99
Jan-02
Jan-05
Jan-08
Jan-11
Jan-14
Jan-17
Sample Date
12BW05
MCL = 5 µg/L

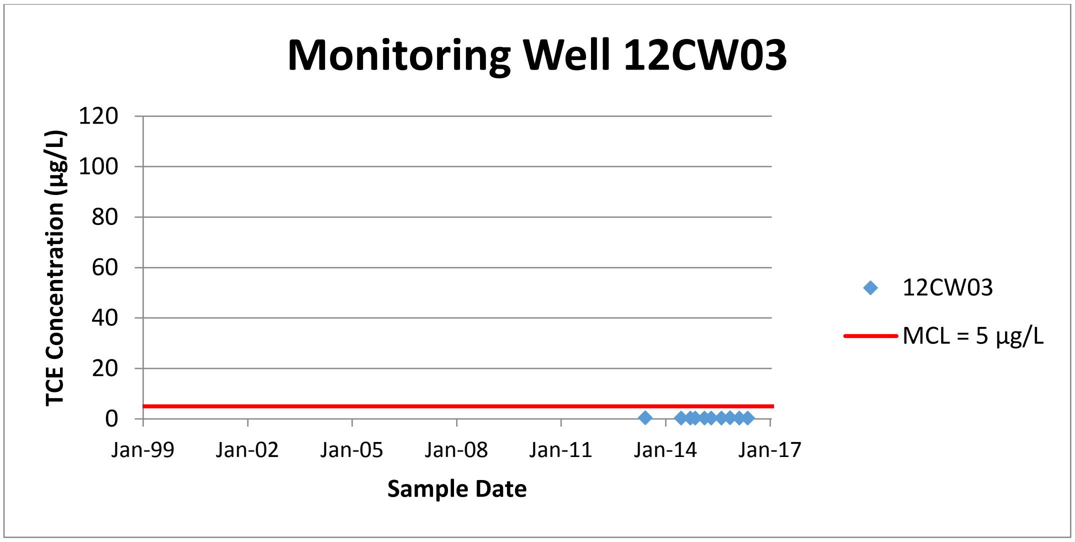

Monitoring Well 12BW06
TCE Concentration (µg/L)
0
20
40
60
80
100
120
Jan-99
Jan-02
Jan-05
Jan-08
Jan-11
Jan-14
Jan-17
Sample Date
12BW06
MCL = 5 µg/L

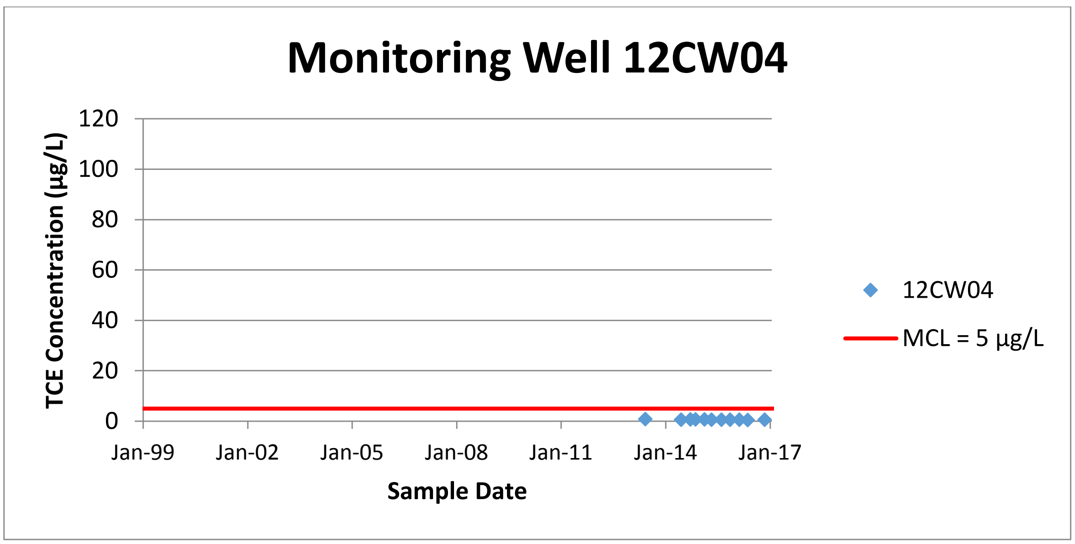

Monitoring Well 12BW07
TCE Concentration (µg/L)
0
20
40
60
80
100
120
Jan-99
Jan-02
Jan-05
Jan-08
Jan-11
Jan-14
Jan-17
Sample Date
12BW07
MCL = 5 µg/L

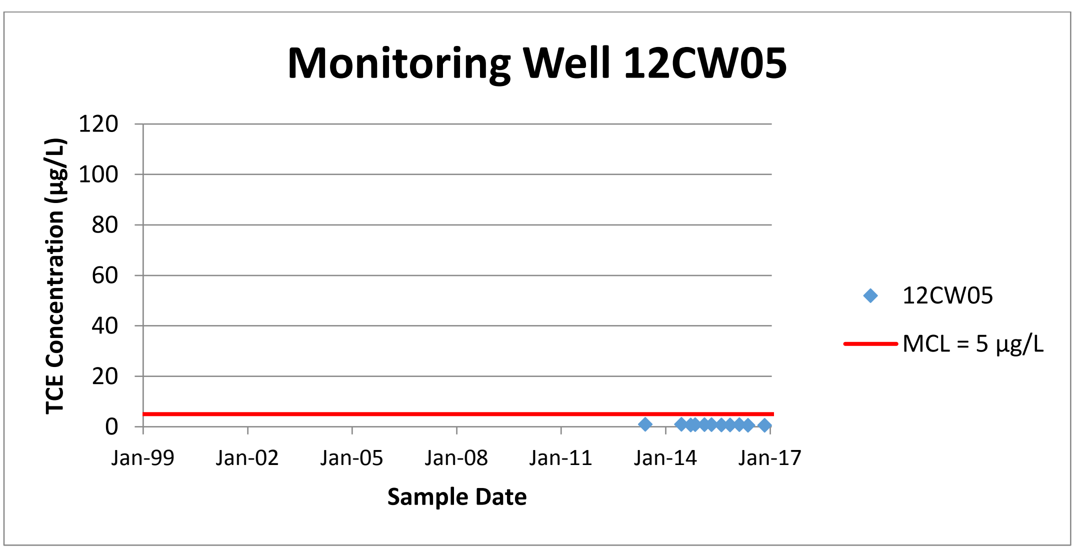

Monitoring Well 12BW08
TCE Concentration (µg/L)
120
100
80
60
40
20
0
Jan-99
Jan-02
Jan-05
Jan-08
Jan-11
Jan-14
Jan-17
Sample Date
12BW08
MCL = 5 µg/L


Monitoring Well 12CW01
TCE Concentration (µg/L)
120
100
80
60
40
20
0
Jan-99
Jan-02
Jan-05
Jan-08
Jan-11
Jan-14
Jan-17
Sample Date
12CW01
MCL = 5 µg/L

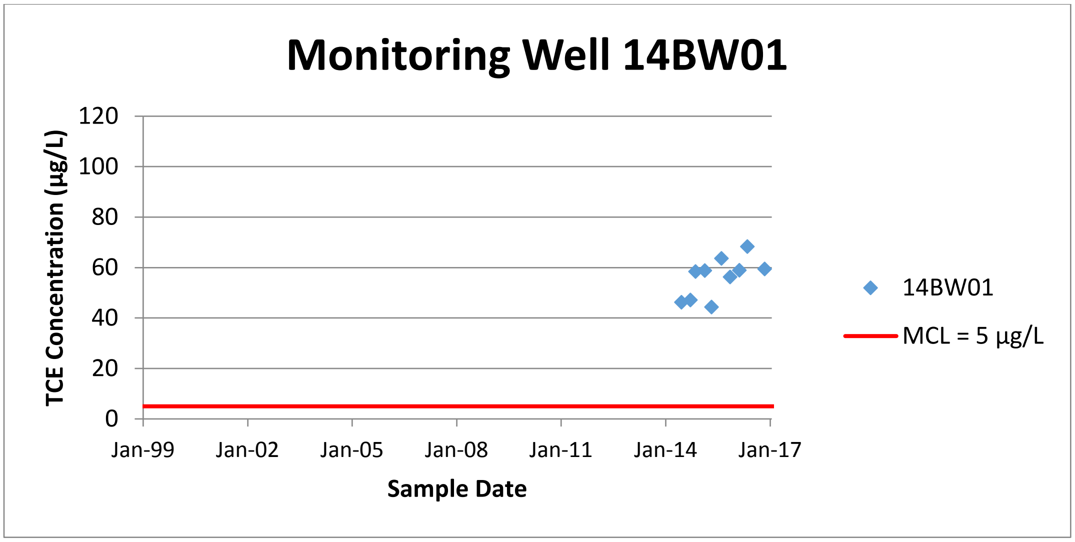

Monitoring Well 12CW02
TCE Concentration (µg/L)
120
100
80
60
40
20
0
Jan-99
Jan-02
Jan-05
Jan-08
Jan-11
Jan-14
Jan-17
Sample Date
12CW02
MCL = 5 µg/L

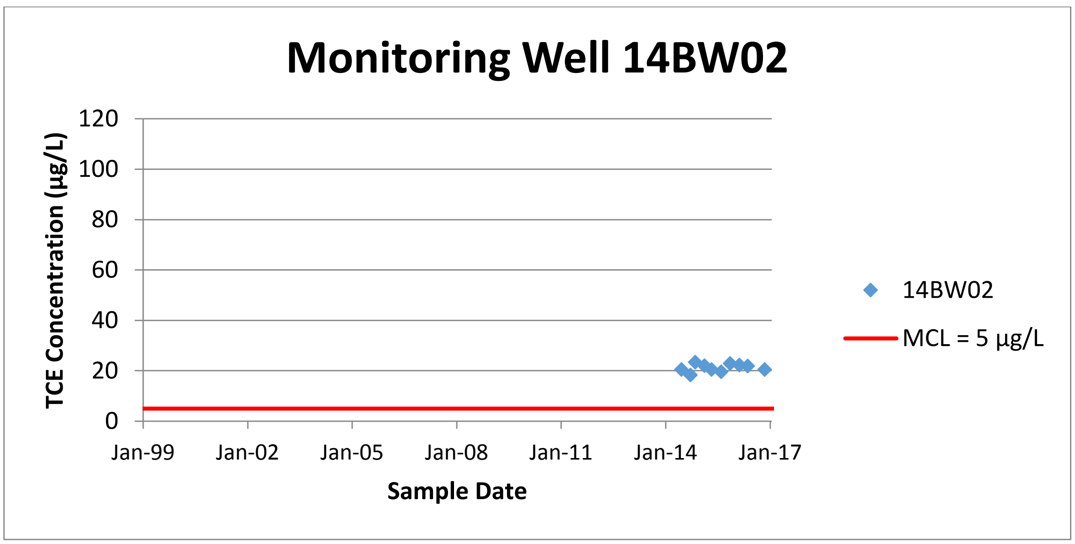

Monitoring Well 12CW03
TCE Concentration (µg/L)
120
100
80
60
40
20
0
Jan-99
Jan-02
Jan-05
Jan-08
Jan-11
Jan-14
Jan-17
Sample Date
12CW03
MCL = 5 µg/L

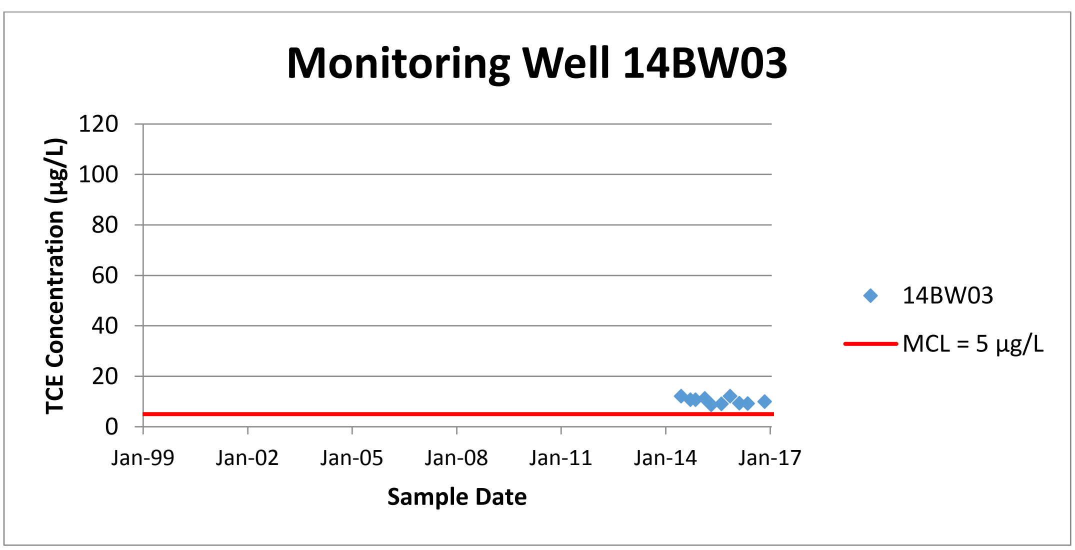

Monitoring Well 12CW04
TCE Concentration (µg/L)
120
100
80
60
40
20
0
Jan-99
Jan-02
Jan-05
Jan-08
Jan-11
Jan-14
Jan-17
Sample Date
12CW04
MCL = 5 µg/L

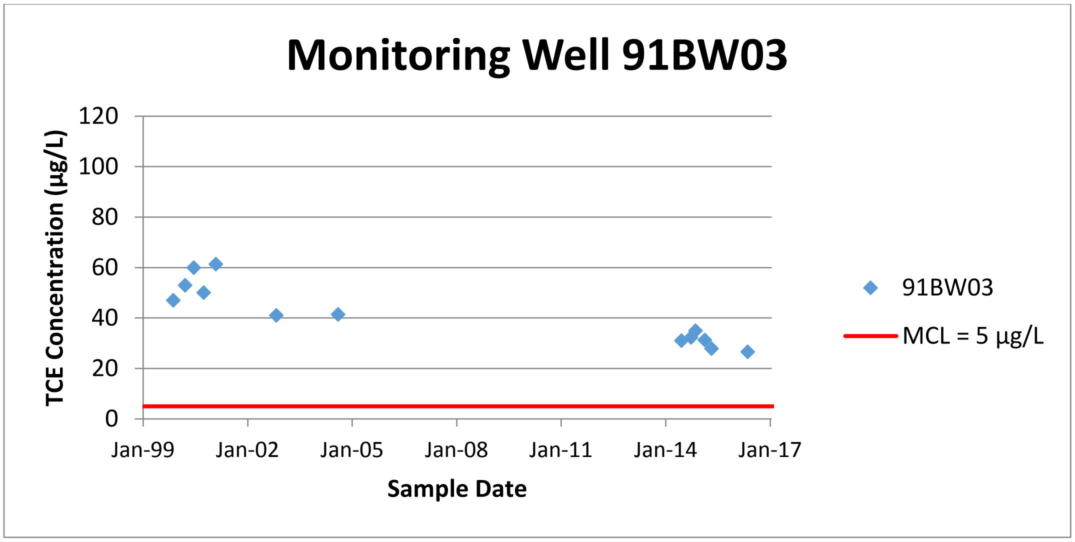

Monitoring Well 12CW05
TCE Concentration (µg/L)
120
100
80
60
40
20
0
Jan-99
Jan-02
Jan-05
Jan-08
Jan-11
Jan-14
Jan-17
Sample Date
12CW05
MCL = 5 µg/L

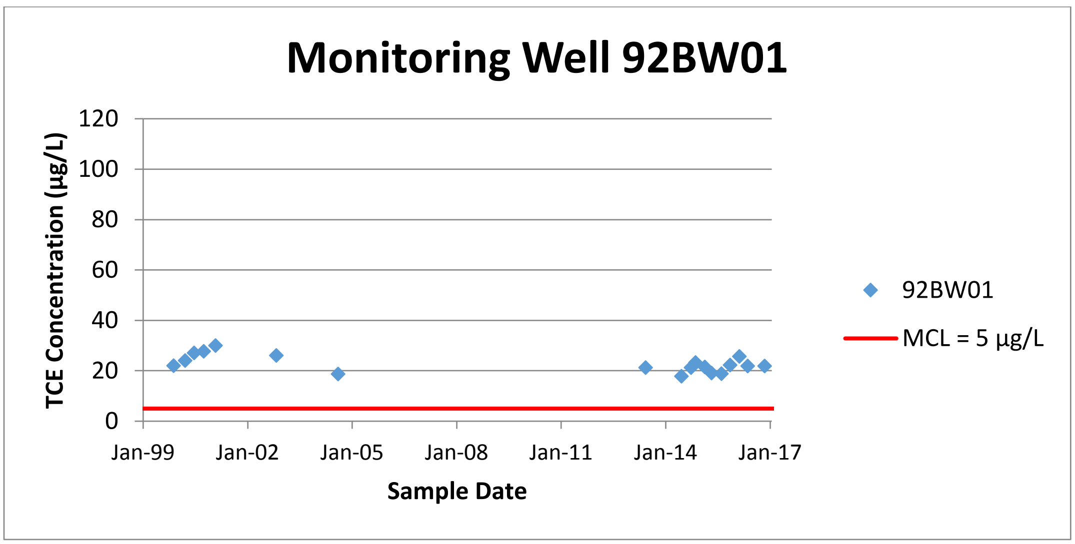
Appendix D - Monitoring Wells

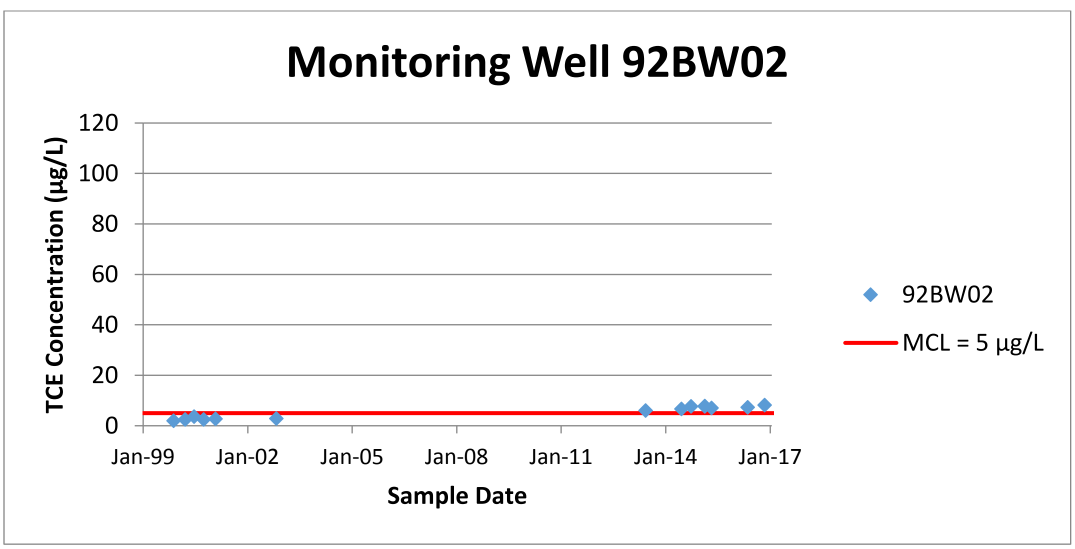


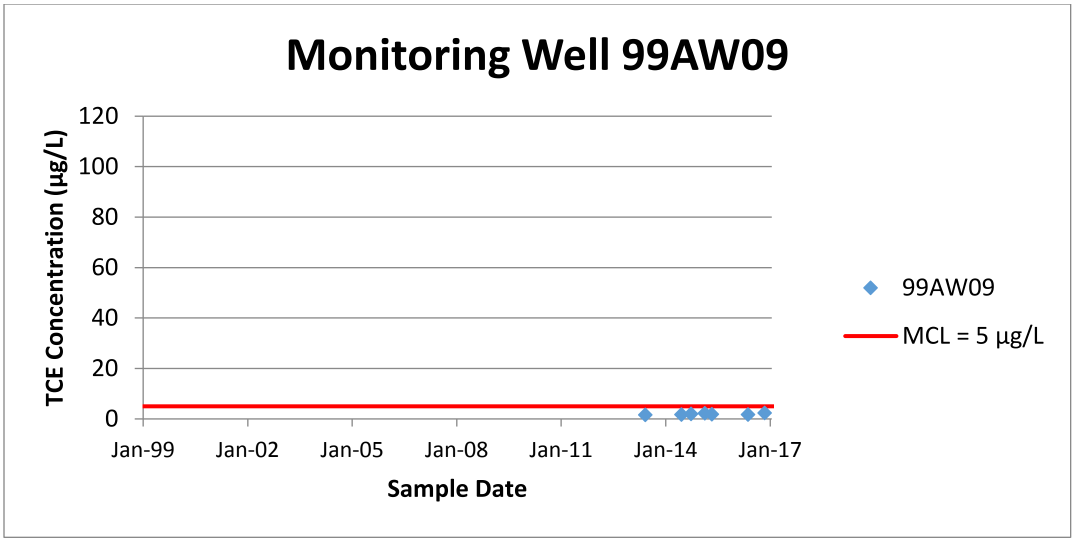


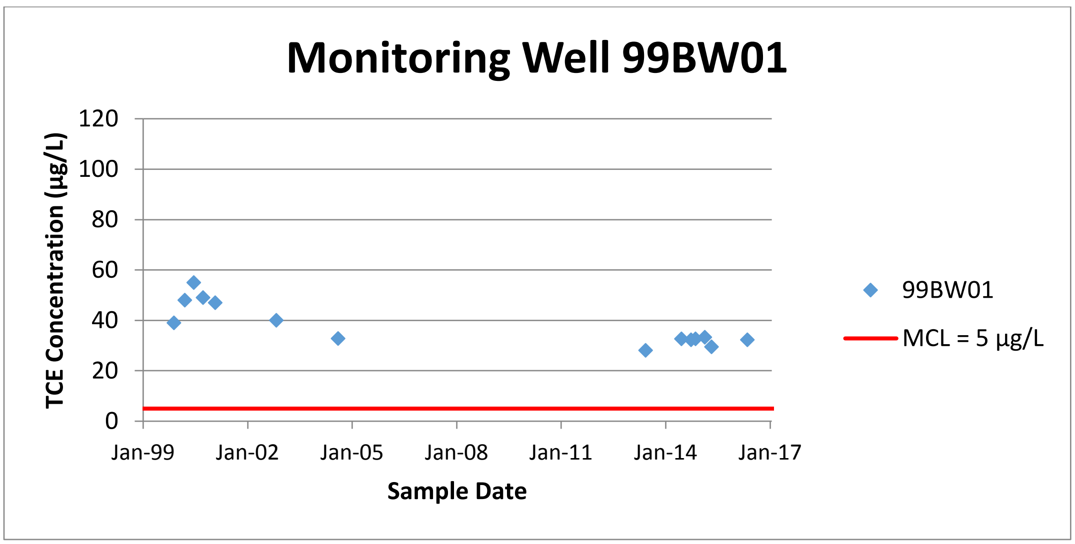


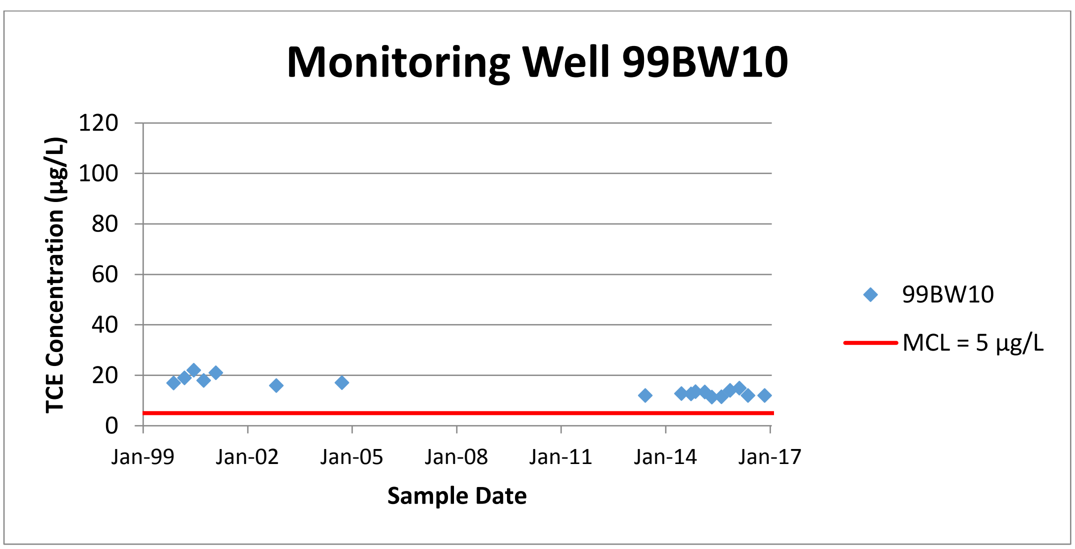

Monitoring Well 91BW03
TCE Concentration (µg/L)
120
100
80
60
40
20
0
Jan-99
Jan-02
Jan-05
Jan-08
Jan-11
Jan-14
Jan-17
Sample Date
91BW03
MCL = 5 µg/L

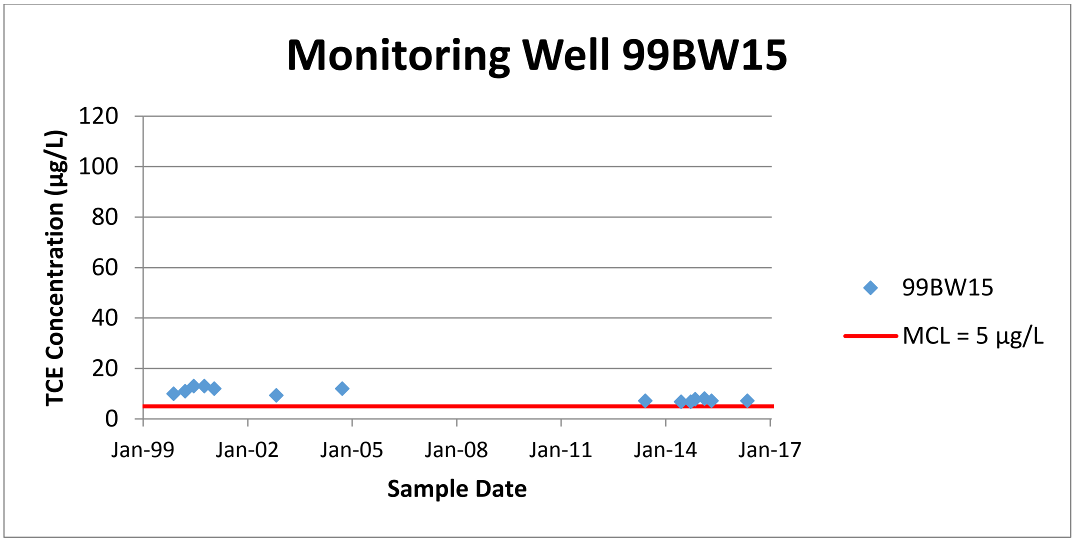

Monitoring Well 92BW01
TCE Concentration (µg/L)
120
100
80
60
40
20
0
Jan-99
Jan-02
Jan-05
Jan-08
Jan-11
Jan-14
Jan-17
Sample Date
92BW01
MCL = 5 µg/L

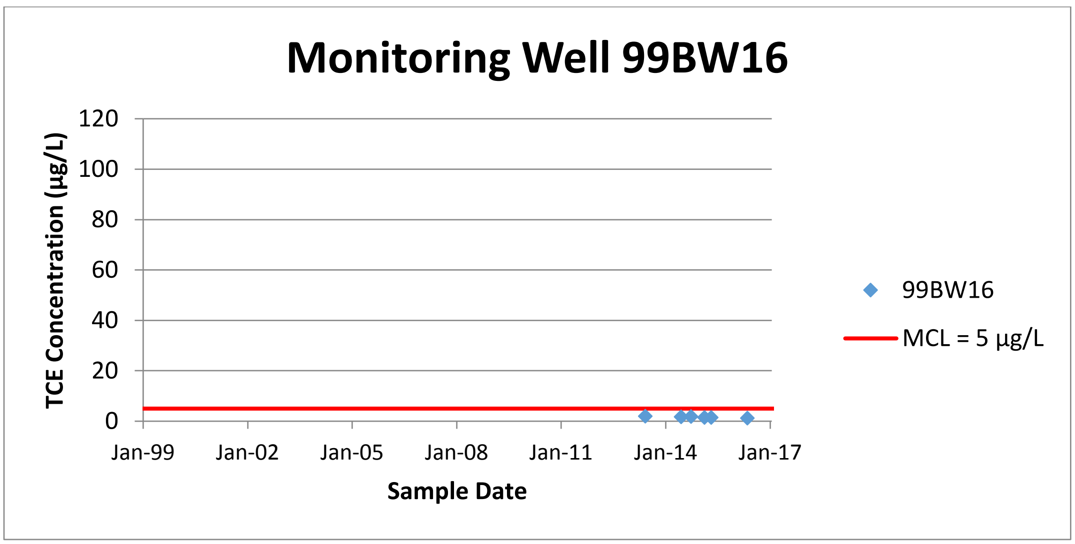

Monitoring Well 92BW02
TCE Concentration (µg/L)
120
100
80
60
40
20
0
Jan-99
Jan-02
Jan-05
Jan-08
Jan-11
Jan-14
Jan-17
Sample Date
92BW02
MCL = 5 µg/L

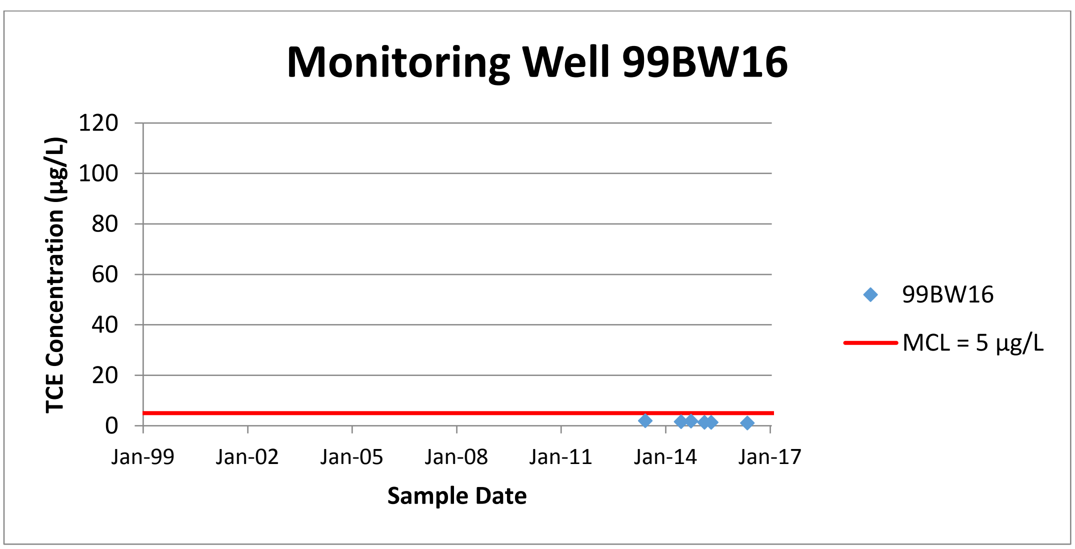

Monitoring Well 99AW09
TCE Concentration (µg/L)
120
100
80
60
40
20
0
Jan-99
Jan-02
Jan-05
Jan-08
Jan-11
Jan-14
Jan-17
Sample Date
99AW09
MCL = 5 µg/L


Monitoring Well 99BW01
TCE Concentration (µg/L)
120
100
80
60
40
20
0
Jan-99
Jan-02
Jan-05
Jan-08
Jan-11
Jan-14
Jan-17
Sample Date
99BW01
MCL = 5 µg/L


Monitoring Well 99BW10
TCE Concentration (µg/L)
120
100
80
60
40
20
0
Jan-99
Jan-02
Jan-05
Jan-08
Jan-11
Jan-14
Jan-17
Sample Date
99BW10
MCL = 5 µg/L


Monitoring Well 99BW15
TCE Concentration (µg/L)
120
100
80
60
40
20
0
Jan-99
Jan-02
Jan-05
Jan-08
Jan-11
Jan-14
Jan-17
Sample Date
99BW15
MCL = 5 µg/L


Monitoring Well 99BW16
TCE Concentration (µg/L)
120
100
80
60
40
20
0
Jan-99
Jan-02
Jan-05
Jan-08
Jan-11
Jan-14
Jan-17
Sample Date
99BW16
MCL = 5 µg/L


Monitoring Well 99BW16
TCE Concentration (µg/L)
120
100
80
60
40
20
0
Jan-99
Jan-02
Jan-05
Jan-08
Jan-11
Jan-14
Jan-17
Sample Date
99BW16
MCL = 5 µg/L

APPENDIX E - Laboratory Data Packages (CD only)

APPENDIX F - Quality Control Summary Report

Appendix F

Final

QUALITY CONTROL SUMMARY REPORT

2016

MOSES LAKE WELLFIELD SUPERFUND SITE

GROUNDWATER MONITORING AND WHOLE HOUSE FILTER PROGRAM

MOSES LAKE, WASHINGTON

CERCLIS ID# WA988466355

Prepared by

U.S. ARMY CORPS OF ENGINEERS

SEATTLE DISTRICT

4735 East Marginal Way South

Seattle, Washington 98134

Prepared for

U.S. ENVIRONMENTAL PROTECTION AGENCY

REGION 10

1200 6th Avenue

Seattle, Washington 98101

February 17, 2016

Contents

ACRONYMS AND ABBREVIATIONS

ADR	Automated Data Review
DOD	Department of Defense
eQAPP	Electronic Quality Assurance Project Plan
EPA	U.S. Environmental Protection Agency
LCS	Laboratory Control Sample
LCSD	Laboratory Control Sample Duplicate
MS	Matrix Spike
MSD	Matrix Spike Duplicate
PCB	Polychlorinated biphenyls
QAPP	Quality Assurance Project Plan
QC	Quality Control
QSM	Quality Systems Manual
RPD	Relative Percent Difference
SDG	Sample Delivery Group
TCMX	Tetrachloro-m-xylene
TOC	Total Organic Carbon
USACE	U.S. Army Corps of Engineers Seattle District
%R	Percent Recovery
mg/L	Milligrams per liter
ug/L	Micrograms per liter

1 Introduction

This Quality Control Summary Report (QCSR) presents Stage 2a and Stage 4 data validation results for samples collected during the February 2016 through November 2016 sampling period. Data validation was performed in accordance with the Final 2016 Work Plan with Quality Assurance Project Plan - for Moses Lake Wellfield Superfund Site, Moses Lake, Washington (QAPP) (USACE, March 2016), U.S. Department of Defense Quality Systems Manual for Environmental Laboratories, Version 5.0 (DOD QSM) (DoD, July 2013), and Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review (CLPNFG) (USEPA, June 2008). Laboratory Data Consultants, Inc., an independent subcontractor to the U.S. Army Corps of Engineers, Seattle District (USACE), performed the data validation task.

This QCSR was based on the outcome of the data review and data validation performed on all laboratory reports submitted by Analytical Resources, Inc. in Tukwila, WA.

The purpose of this QCSR is to provide the project management and data end-users (1) an overview of data quality in terms of precision, accuracy, representativeness, comparability, sensitivity, and completeness, (2) specific data quality anomalies and their effects on data usability, and (3) recommendations to the extent of data usage.

Following the requirements outlined in the QAPP, samples were analyzed with analytical protocols defined in:

- Measurement of Purgeable Organic Compounds in Water by Capillary Column Gas Chromatography/Mass Spectrometry (Method 524.3) EPA 815-B-09-009, June 2009.
- Determination of 1,4-Dioxane in Drinking Water by Solid Phase Extraction and Gas Chromotography/Mass Spectrometry with Selected Ion Monitoring (Method 522) EPA-600-R-08-101, Version 1.0 September 2008
- Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry (Method 8260C) Revision 3 August 2006
- Semi-Volatile Petroleum Products by Gas Chromatograph Equipped with Flame Ionization Detector (Method NWTPH-Dx)

2 Quality Control Activities

During the February 2016 through November 2016 sampling events a total of 336 samples analyzed for volatile organic compounds (VOCs), 20 samples were analyzed for 1,4-dioxane, and 18 samples were analyzed for perfluorinated alkyl acids. The sample identification, collection dates, analyses requested/performed, and validation levels and well identification numbers (IDs) are presented in the DVR attachments.

All sample results were subjected to Stage 2a data validation, which consists of an evaluation of quality control (QC) summary results for sample holding times, surrogates, matrix spike/matrix spike duplicates (MS/MSD), laboratory control sample/laboratory control sample duplicates (LCS/LCSD), method blanks, trip blanks, field blanks, equipment blanks, and field duplicate samples.

A Stage 4 evaluation of the quality control (QC) summary forms as well as initial and continuing calibrations and the raw data was performed on only private drinking water wells.

Based on the data review, the chain-of-custody (COC) forms and sample receipt forms submitted in the analytical reports were clear and complete in all cases. Cooler temperatures were within the 4±2°C criteria.

3 Data Quality Assessment

Based on the outcomes of the data validation, the following sections evaluate if the quality of the data collected during this sampling event achieves the data quality objectives (DQOs) specified in the QAPP. Data quality was determined based on various quality measures commonly referred to as data quality indicators (DQIs) - precision, accuracy/bias, representativeness, comparability, completeness and sensitivity (quantitation limits).

3.1 Data Quality Indicators

Data quality indicators are defined in the following sections. Quality control (QC) parameters evaluated in the data review/validation and the corresponding DQIs are presented as attachments to the DVRs. Definitions of the data quality indicators are provided as follows:

3.1.1 Precision

Precision is defined as the degree of mutual agreement among independent measurements as the result of repeated application of the same process under similar conditions. Analytical precision is evaluated via the relative percent difference (RPD) values of matrix spike/matrix spike duplicate (MS/MSD) and laboratory control sample/ laboratory control sample duplicate (LCS/LCSD). The RPD values of field duplicate analyses represent the combined precision of sample collection and analysis procedures, as well as sample heterogeneity.

3.1.2 Accuracy

Accuracy is a statistical measurement of correctness and includes components of random and systematic errors. It is quantified as the degree of agreement between a measurement with a known reference. Analytical accuracy is evaluated via the percent recovery (%R) values of initial and continuing calibration (percent difference [%D] or percent drift [%Df]), internal standards, surrogate spikes, MS/MSD, LCS/LCSD, in conjunction with method blank, trip blank, and field blank results. Results of blanks assist in identifying the type and magnitude of effects contributed to the system error introduced via field and/or laboratory procedures.

3.1.3 Representativeness

Representativeness is the level of confidence that the analytical data reflects the actual field condition. Representativeness is ensured by maintaining sample integrity during collection, preparation, and analysis. The evaluation of associated method, trip, and field blanks also assists in identifying artifacts that may skew the representativeness of the samples.

3.1.4 Comparability

Comparability is the confidence with which one data set can be compared to another data set. Using standard methods throughout the data generation processes ensures the comparability of data generated in separate sampling days or events.

3.1.5 Completeness

Completeness is a measure of the amount of valid data obtained from a measurement system compared to the amount that was expected to be obtained under normal conditions. Data is complete and valid if it meets all acceptance criteria including accuracy, precision, and any other criteria specified by the particular analytical method being used. Four calculations of completeness are specified in the project QAPP.

Contract compliance completeness falling below the target level may result in the issuance of a corrective action request for the project laboratory. Contract compliance failures are usually the result of lack of corrective action. The impact of contract compliance deficiencies varies with the specific correction action failure and is be determined during the data usability assessment.

$$\text{Contract Completeness} = \frac{\text{\# contract compliant results}}{\text{\# results reported}} \times 100\%$$

Analytical completeness is used to assess the laboratories ability to generate high quality data. This may be a reflection of contract compliance or other issues and requires detail assessment of the cause for qualification during data usability assessment.

$$\text{Analytical Completeness} = \frac{\text{\# unqualified results}}{\text{\# results reported}} \times 100\%$$

(Estimated results are considered as useable for project decision making.)

Technical completeness is a measure which reflects the laboratories ability to produce usable results. The impact of failure to meet this goal will results in serious impacts to data usability (rejected results) and may result in termination of the contract.

$$\textit{Technical Completeness} = \frac{\#\ \textit{useable results}^{\dagger}}{\#\ \textit{results reported}} \times 100\%$$

Field sampling completeness reflects whether the samples planned for collection were actually acquired.

$$\textit{Field Sampling Completeness} = \frac{\#\ \textit{samples collected}}{\#\ \textit{samples planned}} \times 100\%$$

The minimum goals for completeness are as follows: 1) Contract = 100%, 2) Analytical = 90% or greater, 3) Technical = 90% or greater and 4) Field = 100%. The goal for holding times is 100%. Estimated results are treated as usable results for technical completeness. These are considered minimum goals.

3.1.6 Sensitivity

Sensitivity depicts the level of ability an analytical system (i.e., sample preparation and instrumental analysis) of detecting a target component in a given sample matrix with a defined level of confidence. Factors affecting the sensitivity of an analytical system include: analytical system background (e.g., laboratory artifact or method blank contamination), sample matrix (e.g., mass spectrometry ion ratio change, co-elution of peaks, or baseline elevation), instrument instability, and field procedures (including sample transport).

To evaluate if the analytical sensitivity achieved the project expectation, sample-specific project quantitation limits (PQLs) were compared against the reporting limit (RL) goals set forth in the QAPP. In addition, sample results were compared to detections of target analytes in method blanks, and trip blanks to identify potential effects of laboratory background and field procedures on sensitivity.

3.2 Data Quality Indicator Evaluation

The following subsections present an evaluation of the data. The assessment is intended to reconcile the existing data quality with the project DQOs. Assessment is presented herein in terms of the data quality indicators. The qualified data are presented in the DVR attachments.

DQIs for VOC data met the project goals with the following exceptions:

Precision – No RPDs were outside criteria.

Accuracy/Bias – The following QC outliers indicate potential bias of VOC data:

- May 2016: One MS/MSD pairs exceeded the %R acceptance criteria for trichloroethene. No data were qualified due to low or high %R when the associated sample concentration was significantly greater than the spiked concentration.

MS/MSD and LCS/LCSD outlier reports can be found in the DVR attachments.

Representativeness – The following QC outliers indicate potential impact on sample representativeness:

- May 2016: Trichloroethene was detected in one trip blank. The trichloroethene results in samples 1605D99BW12 and 1605N99BW12 were qualified as non-detected (U) due to trip blank contamination.
- November 2016: Trichloroethene was detected in two trip blanks. The trichloroethene results in samples 1611 N 12CW02, 1611 NCW03, 1611 N91 BW04, and 1611 N99AW01 were qualified as non-detected (U) due to trip blank contamination.

Field QC sample data can be found in the DVR attachments.

Completeness – The following list represents completeness outliers for the VOC data:

February 2016

- The contract completeness level attained for the field samples was 99.0 percent. Due to quality control exceedances, 5 out of 480 results were qualified as estimated. Percent contract compliance does not consider surrogate outliers or MS/MSD outliers when associated LCS recoveries are in control.
- The analytical completeness level attained for the field samples was 99.0 percent. Due to quality control exceedances, 5 out of 480 results were qualified as estimated, or non-detected. Holding time completeness was 100%.
- The technical completeness, which included all QC parameters, attained for the field samples was 100 percent. No results were rejected.

May 2016:

- The contract completeness level attained for the field samples was 97.6 percent. Due to quality control exceedances, 36 out of 1524 results were qualified as estimated. Percent contract compliance does not consider surrogate outliers or MS/MSD outliers when associated LCS recoveries are in control.
- The analytical completeness level attained for the field samples was 97.6 percent. Due to quality control exceedances, 36 out of 1524 results were qualified as estimated, or nondetected. Holding time completeness was 100%.
- The technical completeness, which included all QC parameters, attained for the field samples was 100 percent. No results were rejected.

August 2016:

- The contract completeness level attained for the field samples was 97.5 percent. Due to quality control exceedances, 4 out of 160 results were qualified as estimated. Percent contract compliance does not consider surrogate outliers or MS/MSD outliers when associated LCS recoveries are in control.
- The analytical completeness level attained for the field samples was 97.5 percent. Due to quality control exceedances, 4 out of 160 results were qualified as estimated, or non-detected. Holding time completeness was 100%.
- The technical completeness, which included all QC parameters, attained for the field samples was 100 percent. No results were rejected.

November 2016

- The contract completeness level attained for the field samples was 98.2 percent. Due to quality control exceedances, 10 out of 544 results were qualified as estimated. Percent contract compliance does not consider surrogate outliers or MS/MSD outliers when associated LCS recoveries are in control.
- The analytical completeness level attained for the field samples was 98.2 percent. Due to quality control exceedances, 10 out of 544 results were qualified as estimated, or non-detected. Holding time completeness was 100%.
- The technical completeness, which included all QC parameters, attained for the field samples was 100 percent. No results were rejected.

See the DVRs for full completeness reports of each sampling event.

Sensitivity – The target quantitation limits generally meet QAPP requirements. The following exception was noted:

- Target compounds detected below the limit of quantitation (flagged J by the laboratory) should be considered estimated.

Reporting limit outliers are presented in the DVR attachments.

4 Performance Evaluation Samples

One PE sample (15MLW11PE1) was submitted to the laboratory and analyzed for the purpose of evaluating the accuracy of the performance of the measurement or analytical procedures used by the laboratory.

5 Data Usability

The overall quality of the data is acceptable. All project DQIs were met with the exception of those noted above. All sample preservation requirements and all holding times were met. All instrument performance checks and calibrations were performed as required. All calibration factors and internal standard percent recoveries were within acceptance criteria. All surrogate, MS/MSD and LCS/LCSD percent recoveries and RPDs were within acceptance criteria with the exception described in Section 3.2.1. Method blanks, trip blanks, and field blanks were performed at the required frequency. Field duplicates were collected at the required frequency and the precision was considered acceptable. Therefore, all data except those identified above are considered usable with consideration of their data review qualifiers.

6 References

DoD, 2010, Department of Defense Quality Systems Manual for Environmental Laboratories, Version 5.0, July 2013.

EPA, 2008, Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review, USEPA-540-R-08-01, Washington, D.C.

EPA, 2009, Guidance for Labeling Externally Validated Laboratory Analytical Data for Superfund Use, January 2009, EPA 540-R-08-005, Washington, D.C.

Laboratory Data Consultants, Inc., 2006, Automated Data Review, Version 1.5.0.160.

USACE. 2016. Final 2016 Work Plan with Quality Assurance Project Plan. Groundwater Monitoring and Whole-House Filter Program for Moses Lake Wellfield Superfund Site. Former Larson AFB. Moses Lake, Washington. Original December 3, 2015. Final update March 25, 2016.

EPA, 2009, Measurement of Purge able Organic Compounds in Water by Capillary Column Gas Chromatography/Mass Spectrometry: Method 524.3 Version 1, June 2009. USEPA-815-B-09-009. Cincinnati, OH

APPENDIX G – Data Validation Report (CD only)

APPENDIX H – Washington Department of Ecology - New Private Well Query

Appendix H

WATER WELL REPORT

Original & 1st copy – Ecology, 2nd copy – owner, 3rd copy – driller

DEPARTMENT OF ECOLOGY State of Washington

Construction/Decommission *("x" in circle)*

☒ Construction
☐ Decommission *ORIGINAL INSTALLATION*
Notice of Intent Number ______

PROPOSED USE: ☒ Domestic ☐ Industrial ☐ Municipal ☐ DeWater ☐ Irrigation ☐ Test Well ☐ Other ______

TYPE OF WORK: Owner's number of well (if more than one) ______
☒ New well ☐ Reconditioned *Method:* ☐ Dug ☐ Bored ☐ Driven
☐ Deepened ☐ Cable ☒ Rotary ☐ Jetted

DIMENSIONS: Diameter of well 6 inches, drilled 116 ft.
Depth of completed well 116 ft.

CONSTRUCTION DETAILS
Casing Installed: ☒ Welded 6" Diam. from +2 ft. to 85 ft.
☐ Liner installed ___" Diam. from ___ ft. to ___ ft.
☐ Threaded ___" Diam. From ___ ft. to ___ ft.

Perforations: ☐ Yes ☒ No
Type of perforator used ______
SIZE of perfs ___ in. by ___ in. and no. of perfs ___ from ___ ft. to ___ ft.

Screens: ☐ Yes ☒ No ☐ K-Pac Location ______
Manufacturer's Name ______
Type ______ Model No. ______
Diam. ___ Slot size ___ from ___ ft. to ___ ft.
Diam. ___ Slot size ___ from ___ ft. to ___ ft.

Gravel/Filter packed: ☐ Yes ☒ No Size of gravel/sand ______
Materials placed from ___ ft. to ___ ft.

Surface Seal: ☒ Yes ☐ No To what depth? 18 ft.
Material used in seal Bentonite
Did any strata contain unusable water? ☐ Yes ☒ No
Type of water? ______ Depth of strata ______
Method of sealing strata off ______

PUMP: Manufacturer's Name ______
Type: ______ H.P. ______

WATER LEVELS: Land-surface elevation above mean sea level 0 ft.
Static level 50 ft. below top of well Date 4-22-16
Artesian pressure ___ lbs. per square inch Date ______
Artesian water is controlled by ______ (cap, valve, etc.)

WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? ☐ Yes ☒ No If yes, by whom? ______
Yield: ___ gal./min. with ___ ft. drawdown after ___ hrs.
Yield: ___ gal./min. with ___ ft. drawdown after ___ hrs.
Yield: ___ gal./min. with ___ ft. drawdown after ___ hrs.
Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test ______
Bailer test ___ gal./min. with ___ ft. drawdown after ___ hrs.
Airtest 30 gal./min. with stem set at 116 ft. for 1 hrs.
Artesian flow ___ g.p.m. Date ______
Temperature of water ___ Was a chemical analysis made? ☐ Yes ☒ No

CURRENT

Notice of Intent No. WE23191
Unique Ecology Well ID Tag No. BJD 493
Water Right Permit No (b) (6) [redacted]
Property Owner Name [redacted]
Well Street Address [redacted]
City Moses Lake County Grant
Location NW 1/4-1/4 NW 1/4 Sec 16 Twn 19 R 28 EWM ☒ Or WWM ☐
(s, t, r Still REQUIRED)

Lat/Long Lat Deg ___ Lat Min/Sec ___
Long Deg ___ Long Min/Sec ___
Tax Parcel No. (Required) 171116000

CONSTRUCTION OR DECOMMISSION PROCEDURE
Formation: Describe by color, character, size of material and structure, and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information. (USE ADDITIONAL SHEETS IF NECESSARY.)

MATERIAL	FROM	TO
Silt/Dirt	0	5
Sand	5	20
Gravel	20	35
Brown Clay	35	80
Sandstone	80	85
Basalt	85	95
Broken Basalt (H2O)	95	116

RECEIVED
MAY 05 2016
Department of Ecology
Eastern Washington Office

Start Date 4-22-16 Completed Date 4-22-16

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

☒ Driller ☐ Engineer ☐ Trainee Name (Print) Kevin Boyd
Driller/Engineer/Trainee Signature [signature]
Driller or trainee License No. 2996
IF TRAINEE: Driller's License No: David Rodeman
Driller's Signature:

Drilling Company Empire Well Drilling LLC
Address PO. Box 3854
City, State, Zip Wenatchee, WA 98807
Contractor's Registration No. EMPIRWD876MN Date 4-22-16

ECY 050-1-20 (Rev 02/10) *If you need this document in an alternate format, please call the Water Resources Program at 360-407-6872. Persons with hearing loss can call 711 for Washington Relay Service. Persons with a speech disability can call 877-833-6341.*

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report

Appendix H

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report

DEPARTMENT OF ECOLOGY State of Washington

WATER WELL REPORT

Original & 1st copy – Ecology, 2nd copy – owner, 3rd copy – driller

Construction/Decommission *("x" in circle)*
[X] Construction
[ ] Decommission *ORIGINAL INSTALLATION Notice of Intent Number* ______

CURRENT
Notice of Intent No. WE 20147
Unique Ecology Well ID Tag No. BHW 097
Water Right Permit No. NO
Property Owner Name (b) (6) [redacted]
Well Street Address [redacted]
City Moses Lake County Grant
Location SW 1/4-1/4 SW 1/4 Sec 8 Twn 19 R 28 EWM [X] Or WWM [ ]
(s, t, r Still REQUIRED)

Lat/Long Lat Deg ____ Lat Min/Sec ____
Long Deg ____ Long Min/Sec ____
Tax Parcel No. (Required) 120919000

PROPOSED USE: [X] Domestic [ ] Industrial [ ] Municipal [ ] DeWater [ ] Irrigation [ ] Test Well [ ] Other ______

TYPE OF WORK: Owner's number of well (if more than one) ____
[X] New well [ ] Reconditioned *Method:* [ ] Dug [ ] Bored [ ] Driven
[ ] Deepened [ ] Cable [X] Rotary [ ] Jetted

DIMENSIONS: Diameter of well 6 inches, drilled 140 ft.
Depth of completed well 140 ft.

CONSTRUCTION DETAILS
Casing Installed: [X] Welded 6 " Diam. from +3 ft. to 110 ft.
[ ] Liner installed ____ " Diam. from ____ ft. to ____ ft.
[ ] Threaded ____ " Diam. From ____ ft. to ____ ft.

Perforations: [ ] Yes [X] No
Type of perforator used ______
SIZE of perfs ____ in. by ____ in. and no. of perfs ____ from ____ ft. to ____ ft.

Screens: [ ] Yes [X] No [ ] K-Pac Location ______
Manufacturer's Name ______
Type ______ Model No. ______
Diam. ____ Slot size ____ from ____ ft. to ____ ft.
Diam. ____ Slot size ____ from ____ ft. to ____ ft.

Gravel/Filter packed: [ ] Yes [X] No Size of gravel/sand ____
Materials placed from ____ ft. to ____ ft.

Surface Seal: [X] Yes [ ] No To what depth? 18 ft.
Material used in seal Dry Bentonite
Did any strata contain unusable water? [X] Yes [ ] No
Type of water? Surface Depth of strata 34'–42', 68'–84'
Method of sealing strata off Cased

PUMP: Manufacturer's Name ______
Type: ______ H.P. ____

WATER LEVELS: Land-surface elevation above mean sea level ____ ft.
Static level 36 ft. below top of well Date 5/6/15
Artesian pressure ____ lbs. per square inch Date ______
Artesian water is controlled by ______ (cap, valve, etc.)

WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? [ ] Yes [X] No If yes, by whom? ______
Yield: ____ gal./min. with ____ ft. drawdown after ____ hrs.
Yield: ____ gal./min. with ____ ft. drawdown after ____ hrs.
Yield: ____ gal./min. with ____ ft. drawdown after ____ hrs.
Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test ______
Bailer test ____ gal./min. with ____ ft. drawdown after ____ hrs.
Airtest 20 gal./min. with stem set at 138 ft. for 2 hrs.
Artesian flow ____ g.p.m. Date 5/6/15
Temperature of water ____ Was a chemical analysis made? [ ] Yes [X] No

CONSTRUCTION OR DECOMMISSION PROCEDURE
Formation: Describe by color, character, size of material and structure, and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information. (USE ADDITIONAL SHEETS IF NECESSARY.)

MATERIAL	FROM	TO
TopSoil	0'	1'
Cobbles & Gravel	1'	28'
Gravel	28'	34'
Gravel & H2O	34'	40'
Gravel, H2O & Brown Clay	40'	42'
Brown Clay	42'	68'
Tan Soft Clay & Sand H2O	68'	84'
Sticky Brown Clay	84'	91'
Gray Clay	91'	102'
Brown clay	102'	106'
Brown Basalt & Brown Clay	106'	108'
Brown Basalt Soft H2O	108'	140'

RECEIVED
MAY 18 2015
Department of Ecology
Eastern Regional Office

Start Date 5/6/15 Completed Date 5/6/15

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

[ ] Driller [ ] Engineer [X] Trainee Name (Print) Cole
Driller/Engineer/Trainee Signature D. Cozad
Driller or trainee License No. 3165 T
IF TRAINEE: Driller's License No: 1267
Driller's Signature: Mitch Martin

Drilling Company DC Drilling Inc
Address PO Box 1269
City, State, Zip Royal City WA 99357
Contractor's Registration No. DCDRI CD875OF Date 5/6/15

ECY 050-1-20 (Rev 02/10) *If you need this document in an alternate format, please call the Water Resources Program at 360-407-6872. Persons with hearing loss can call 711 for Washington Relay Service. Persons with a speech disability can call 877-833-6341.*

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report

DEPARTMENT OF ECOLOGY State of Washington

WATER WELL REPORT

Original & 1st copy – Ecology, 2nd copy – owner, 3rd copy – driller

Construction/Decommission *("x" in circle)*

☒ Construction

☐ Decommission *ORIGINAL INSTALLATION Notice of Intent Number* ______

CURRENT

Notice of Intent No. W362415

Unique Ecology Well ID Tag No. BIU598

Water Right Permit No. NO

Property Owner Name (b) (6) [redacted]

Well Street Address

City MoseSLake County Grant

Location NE 1/4-1/4 NW 1/4 Sec 8 Twn 19 R 28 EWM ☒ Or WWM ☐

(s, t, r Still REQUIRED)

Lat/Long Lat Deg ____ Lat Min/Sec ____ Long Deg ____ Long Min/Sec ____

Tax Parcel No. (Required) 120664 110

PROPOSED USE: ☒ Domestic ☐ Industrial ☐ Municipal ☐ DeWater ☐ Irrigation ☐ Test Well ☐ Other ______

TYPE OF WORK: Owner's number of well (if more than one) ______

☒ New well ☐ Reconditioned *Method:* ☐ Dug ☐ Bored ☐ Driven

☐ Deepened ☐ Cable ☒ Rotary ☐ Jetted

DIMENSIONS: Diameter of well 6 inches, drilled 240 ft.

Depth of completed well 240 ft.

CONSTRUCTION DETAILS

Casing Installed: ☒ Welded 6" Diam. from +2 ft. to 118 ft.

☒ Liner installed 4" Diam. from -20 ft. to 240 ft.

☐ Threaded ____" Diam. From ____ ft. to ____ ft.

Perforations: ☒ Yes ☐ No

Type of perforator used Saw CuT

SIZE of perfs 1/4 in. by 7 in. and no. of perfs 90 from 200 ft. to 240 ft.

Screens: ☐ Yes ☒ No ☐ K-Pac Location ______

Manufacturer's Name ______

Type ______ Model No. ______

Diam. ____ Slot size ____ from ____ ft. to ____ ft.

Diam. ____ Slot size ____ from ____ ft. to ____ ft.

Gravel/Filter packed: ☐ Yes ☒ No Size of gravel/sand ______

Materials placed from ____ ft. to ____ ft.

Surface Seal: ☒ Yes ☐ No To what depth? 18 ft.

Material used in seal Dry Bentonite

Did any strata contain unusable water? ☒ Yes ☐ No

Type of water? Surface Depth of strata 48'—55'

Method of sealing strata off Cased Off

PUMP: Manufacturer's Name ______

Type: ______ H.P. ______

WATER LEVELS: Land-surface elevation above mean sea level ____ ft.

Static level 63 ft. below top of well Date 2/10/16

Artesian pressure ____ lbs. per square inch Date ______

Artesian water is controlled by ______ (cap, valve, etc.)

WELL TESTS: Drawdown is amount water level is lowered below static level

Was a pump test made? ☐ Yes ☒ No If yes, by whom? ______

Yield: ____ gal./min. with ____ ft. drawdown after ____ hrs.

Yield: ____ gal./min. with ____ ft. drawdown after ____ hrs.

Yield: ____ gal./min. with ____ ft. drawdown after ____ hrs.

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test ______

Bailer test ____ gal./min. with ____ ft. drawdown after ____ hrs.

Airtest 60+ gal./min. with stem set at 238 ft. for 2 hrs.

Artesian flow ____ g.p.m. Date 2/10/16

Temperature of water ____ Was a chemical analysis made? ☐ Yes ☒ No

CONSTRUCTION OR DECOMMISSION PROCEDURE

Formation: Describe by color, character, size of material and structure, and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information. (USE ADDITIONAL SHEETS IF NECESSARY.)

MATERIAL	FROM	TO
TopSoiL	0'	1'
Cobbles	1'	24'
Gravel	24'	48'
GravelR H2O	48'	53'
Gravel & Brown Clay H2O	53'	55'
Brown Clay Dry	55'	94'
Tan Clay	94'	115'
Gray Clay STicky Brown BasalT	115'	125'
Brown Clay	125'	131'
Gray BasalT	131'	153'
Red BasalT Cavey	153'	157'
Gray BasalT Hard	157'	226'
H2O Brown Broken BasalT	226'	237'
Black BasalT H2O	237	240'

RECEIVED

APR 26 2016

Department of Ecology

Eastern Regional Office

Start Date 2/10/15 Completed Date 2/10/15

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

☒ Driller ☐ Engineer ☐ Trainee Name (Print) D. Cole

Driller/Engineer/Trainee Signature D. Cole

Driller or trainee License No. 3165

IF TRAINEE: Driller's License No: ______

Driller's Signature: ______

Drilling Company D C Drilling Inc

Address PO Box 1269

City, State, Zip Royal City WA 99357

Contractor's Registration No. DCD8RICD870F Date 2/10/15

WATER WELL REPORT

Original & 1st copy – Ecology, 2nd copy – owner, 3rd copy – driller

DEPARTMENT OF ECOLOGY State of Washington

Construction/Decommission (*"x" in circle*)

☒ Construction

☐ Decommission *ORIGINAL INSTALLATION Notice of Intent Number* ____

CURRENT

Notice of Intent No. W362314

Unique Ecology Well ID Tag No. BHW096

Water Right Permit No. NO

Property Owner Name (b) (6) [redacted]

Well Street Address [redacted]

City Moses Lake County Grant

Location SW 1/4-1/4 SW 1/4 Sec 9 Twn 19 R 28 EWM ☒ Or WWM ☐

(s, t, r Still REQUIRED)

Lat/Long Lat Deg ____ Lat Min/Sec ____ Long Deg ____ Long Min/Sec ____

Tax Parcel No. (Required) 313482000

PROPOSED USE: ☒ Domestic ☐ Industrial ☐ Municipal ☐ DeWater ☐ Irrigation ☐ Test Well ☐ Other ____

TYPE OF WORK: Owner's number of well (if more than one) ____

☒ New well ☐ Reconditioned *Method:* ☐ Dug ☐ Bored ☐ Driven ☐ Deepened ☐ Cable ☒ Rotary ☐ Jetted

DIMENSIONS: Diameter of well 6 inches, drilled 140 ft. Depth of completed well 140 ft.

CONSTRUCTION DETAILS

Casing Installed: ☒ Welded 6" Diam. from +3 ft. to 90 ft.

☐ Liner installed ____" Diam. from ____ ft. to ____ ft.

☐ Threaded ____" Diam. From ____ ft. to ____ ft.

Perforations: ☐ Yes ☒ No

Type of perforator used ____

SIZE of perfs ____ in. by ____ in. and no. of perfs ____ from ____ ft. to ____ ft.

Screens: ☐ Yes ☒ No ☐ K-Pac Location ____

Manufacturer's Name ____

Type ____ Model No. ____

Diam. ____ Slot size ____ from ____ ft. to ____ ft.

Diam. ____ Slot size ____ from ____ ft. to ____ ft.

Gravel/Filter packed: ☐ Yes ☒ No Size of gravel/sand ____

Materials placed from ____ ft. to ____ ft.

Surface Seal: ☒ Yes ☐ No To what depth? 18 ft.

Material used in seal Dry Bentonite

Did any strata contain unusable water? ☒ Yes ☐ No

Type of water? Surface Depth of strata 22'

Method of sealing strata off Casing

PUMP: Manufacturer's Name ____

Type: ____ H.P. ____

WATER LEVELS: Land-surface elevation above mean sea level ____ ft.

Static level 49 ft. below top of well Date 5/5/15

Artesian pressure ____ lbs. per square inch Date ____

Artesian water is controlled by ____ (cap, valve, etc.)

WELL TESTS: Drawdown is amount water level is lowered below static level

Was a pump test made? ☐ Yes ☒ No If yes, by whom? ____

Yield: ____ gal./min. with ____ ft. drawdown after ____ hrs.

Yield: ____ gal./min. with ____ ft. drawdown after ____ hrs.

Yield: ____ gal./min. with ____ ft. drawdown after ____ hrs.

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test ____

Bailer test ____ gal./min. with ____ ft. drawdown after ____ hrs.

Airtest 23 gal./min. with stem set at 138 ft. for 2 hrs.

Artesian flow ____ g.p.m. Date 5/5/15

Temperature of water ____ Was a chemical analysis made? ☐ Yes ☒ No

CONSTRUCTION OR DECOMMISSION PROCEDURE

Formation: Describe by color, character, size of material and structure, and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information. (USE ADDITIONAL SHEETS IF NECESSARY.)

MATERIAL	FROM	TO
TopSoil	0	1'
Cobbles & gravel	1'	17'
gravel	17'	51'
gravel & H2O	51'	73'
Brown Clay	73'	85'
Brown Clay & Brown Basalt	85'	94'
Brown Basalt & H2O	94'	127'
Hard gray Basalt	127'	133'
Black Basalt medium Little H2O	133'	138'
Hard Gray Basalt	138'	140'

RECEIVED

MAY 10 2015

Department of Ecology Eastern Regional Office

Start Date 5/5/15 Completed Date 5/5/15

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

☐ Driller ☐ Engineer ☒ Trainee Name (Print) Cole

Driller/Engineer/Trainee Signature D. Cole

Driller or trainee License No. 3165 T

IF TRAINEE: Driller's License No: 1267

Driller's Signature: Mitch Martin

Drilling Company DC Drilling Inc

Address PO Box 1289

City, State, Zip Royal City WA 99357

Contractor's Registration No. DCDRICD875OF Date 5/5/15

 If you need this document in an alternate format, please call the Water Resources Program at 360-407-6872. Persons with hearing loss can call 711 for Washington Relay Service. Persons with a speech disability can call 877-833-6341.

Appendix H

WATER WELL REPORT

Original & 1st copy – Ecology, 2nd copy – owner, 3rd copy – driller

DEPARTMENT OF ECOLOGY State of Washington

Construction/Decommission *("x" in circle)*

☒ Construction

☐ Decommission *ORIGINAL INSTALLATION*

Notice of Intent Number ______

CURRENT

Notice of Intent No. **WE23419**

Unique Ecology Well ID Tag No. **BIB 315**

Water Right Permit No. ______

Property Owner Name **City Of Moses Lake**

Well Street Address **8213 Randolph Rd NE**

City Moses Lake County Grant

Location NW1/4-1/4 **SW**1/4 Sec **27** Twn **20n** R **28** **EWM** ☒ Or **WWM** ☐

(s, t, r Still REQUIRED)

Lat/Long

Lat Deg ____ Lat Min/Sec ____

Long Deg ____ Long Min/Sec ____

Tax parcel No. (Required) **12-0682-301**

PROPOSED USE: ☐ Domestic ☐ Industrial ☒ Municipal ☐ DeWater ☐ Irrigation ☐ Test Well ☐ Other ______

TYPE OF WORK: Owner's number of well (if more than one) ____

☒ New well ☐ Reconditioned *Method:* ☐ Dug ☐ Bored ☐ Driven

☐ Deepened ☐ Cable ☒ Rotary ☐ Jetted

DIMENSIONS: Diameter of well **20** inches, drilled **70.5** ft.

Depth of completed well **72** ft.

CONSTRUCTION DETAILS

Casing Installed: ☒ Welded **20**" Diam. from **+1.5** ft. to **37.5** ft.

☐ Liner installed ____" Diam. from ____ ft. to ____ ft.

☐ Threaded ____" Diam. From ____ ft. to ____ ft.

Perforations: ☐ Yes ☒ No

Type of perforator used ______

SIZE of perfs ____ in. by ____ in. and no. of perfs ____ from ____ ft. to ____ ft.

Screens: ☒ Yes ☐ No ☐ K-Pac Location ______

Manufacturer's Name **Alloy Machine Works**

Type **S.S** Model No. **Pipe Size**

Diam. **18"** Slot size **.100** from **39.2** ft. to **60.4** ft.

Diam. **18"** Slot size **sump** from **60.4** ft. to **70.5** ft.

Gravel/Filter packed: ☐ Yes ☒ No Size of gravel/sand ____

Materials placed from ____ ft. to ____ ft.

Surface Seal: ☒ Yes ☐ No To what depth? **18**ft.

Material used in seal **Bentonite Chips**

Did any strata contain unusable water? ☐ Yes ☒ No

Type of water? ______ Depth of strata ______

Method of sealing strata off ______

PUMP: Manufacturer's Name ______

Type: ______ H.P. ______

WATER LEVELS: Land-surface elevation above mean sea level ____ ft.

Static level **35.9** ft. below top of well Date **3-31-16**

Artesian pressure ____ lbs. per square inch Date ______

Artesian water is controlled by ______ (cap, valve, etc.)

WELL TESTS: Drawdown is amount water level is lowered below static level

Was a pump test made? ☒ Yes ☐ No If yes, by whom? **TP@D**

Yield: **1020** gal./min. with **.42** ft. drawdown after **2.5** hrs.

Yield: **1515** gal./min. with **1.35** ft. drawdown after **3** hrs.

Yield: **1930** gal./min. with **2** ft. drawdown after **2** hrs.

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level
1min	**38.53**				

Date of test **6-9-16**

Bailer test ____ gal./min. with ____ ft. drawdown after ____ hrs.

Airtest ____ gal./min. with stem set at ____ ft. for ____ hrs.

Artesian flow ____ g.p.m. Date ______

Temperature of water **58** Was a chemical analysis made? ☒ Yes ☐ No

CONSTRUCTION OR DECOMMISSION PROCEDURE

Formation: Describe by color, character, size of material and structure, and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information. (USE ADDITIONAL SHEETS IF NECESSARY.)

MATERIAL	FROM	TO
Fine silty topsoil.	**0**	**1**
Course gravels and cobbles.	**1**	**8**
Grey brown clayey course gravel, cobbles.	**8**	**21**
Boulder	**21**	**24**
Medium to course gravel, cobbles.	**24**	**41**
Looser medium to course sand and gravels,	**41**	**50**
some visicular basalt gravel with light brown		
silt.		
Wet medium to course gravel, cobbles.	**50**	**57**
Grey brown weathered basalt.	**57**	**63**
Fractured grey basalt, oxidized	**63**	**70.5**

RECEIVED

JUN 20 2016

Department of Ecology Eastern Washington Office

Start Date **3-22-16** Completed Date **4-7-16**

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

☒ Driller ☐ Engineer ☐ Trainee Name (Print) **MattCall**

Driller/Engineer/Trainee Signature

Driller or trainee License No. **2467**

IF TRAINEE: Driller's License No:

Driller's Signature: Matt Call

Drilling Company **Tacoma Pump @ Drilling**

Address **30316 Mountain Hwy**

City, State, Zip **Graham**, **Wa**, **98338**

Contractor's Registration No. **TACOMPD203PF** Date **6-16-16**

ECY 050-1-20 (Rev 02-2010) To request ADA accommodation including materials in a format for the visually impaired, call Ecology Water Resources Program at 360-407-6872. Persons with impaired hearing may call Washington Relay Service at 711. Persons with speech disability may call TTY at 877-833-6341.